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THE INTERNATIONAL GEOGRAPHICAL CONGRESS IN LONDON.

THE meeting of the Sixth International Congress commenced at the Imperial Institute on the evening of Friday, the 26th of July last, by the presentation of the foreign delegates to the Duke of York as Honorary President, who subsequently took the chair in the Great Hall of the Institute and addressed the members of the Congress, extending a welcome and expressing his hope that their proceedings would be productive of great benefit to geographical science. His Royal Highness was followed by Mr. Clements Markham, F.R.S., the President of the Congress, who also offered a warm welcome to all, and especially to the foreign visitors, whom he congratulated on the gathering together of such an assembly of eminent geographers, and on the progress that had been made in geographical discovery. Chief Justice Daly, President of the Geographical Society of New York, on behalf of the foreign delegates, thanked the Congress for the hearty welcome they had received.

THE PRESIDENTIAL ADDRESS.

The presidential address of Mr. Clements Markham was delivered at the general meeting of the Congress on Saturday morning, after a letter from the King of the Belgians had been read, in which His Majesty expressed his regret at his inability to be present.

The President said that, as nations paid differing amounts of attention to the various branches of geography, it was desirable that the line of general advance should be, as it were, dressed by an international gathering of geographers. In the matter of geographical education England was behind other nations, for although geography was the mother of sciences, the English Universities had not yet recognized it as a science. It was time, therefore, that the training of teachers in geography for secondary schools should be taken in hand independently of the Universities. The Royal Geographical Society had for the last fifteen years aided the scientific study of geography, since it was of great importance that explorers should be able by correct surveying, etc., to bring home accurate reports and maps. Locality was the basis on which all human knowledge rested; hence the importance of stimulating the execution of accurate surveying could not be exaggerated. Cartography, and the bibliography and orthography of geography were important also, and it was now highly desirable to adopt a uniform system of transliterating geographical names. With respect to the Polar regions, the time had long gone by when it was necessary to argue in favour of Arctic exploration. There was not sufficient known of the North Polar region to give correct general ideas of the relative extent of land and sea, of the laws regulating winds and currents, of the biological distribution, or of the geological history of that most interesting part of the globe which was the first to become sufficiently cool to sustain life. Expeditions ought to be undertaken from at least five different directions, but ships ought not to be sent out for the mere purpose of reaching the Pole, but for thorough investigation in the interests of physical science. Though Weyhrecht's plan of simultaneous observations at fixed points was admirable, he thought geographical discovery ought to be the principal object of an expedition.

Then followed an interesting historical review of the contributions to the exploration of the globe by the various nations of Europe and by the United States in the following order, as indicating precedence:—Italy, Portugal, Spain, France, Holland, Belgium, Germany, Austria-Hungary, Switzerland, Russia, Sweden, Norway, Denmark, and the United States.

The President concluded by again offering a most cordial welcome to the distinguished geographers present.

Prince Roland Bonaparte proposed that the thanks of the Congress be given to the President for his address, and this was seconded by Prof. Von den Steinen, and carried with acclamation.

GEOGRAPHICAL EDUCATION.

Prof. E. Levasseur, in his paper, "Geography in Schools and in the University," advocated, in primary education, commencing with a description of the place where the school is situated, because it is based on things, not on words, and leads the pupil to reflect and understand what is taught. At the outset the plan of the schoolroom teaches what a map is, and leads to the comprehension of a plan of the surrounding district, with which the pupil is presumably well acquainted. Globes are necessary to teach the shape of the earth. Three notions should be absorbed by the pupil—the name of the thing, the shape of the thing, and the meaning of the thing. Besides good maps and globes, and a blackboard, correct relief maps, if obtainable, should be used. In France, in secondary education, since 1872, physical geography has occupied the first place, then historical

and political geography, and thirdly, economic geography. Higher geographical teaching is given in the College of France, and in some special schools in the Facultés des Lettres, rarely in the Facultés des Sciences. The views of Prof. Levasseur were supported by Señor Torres Campos, and M. Drapeyron pointed out the value of geographical walking excursions.

In a paper "On the Training of Geography Teachers in the Universities," Prof. Lehmann insisted on the following requirements: outlines of mathematical geography, general physical geography, general ethnology, special descriptive geography, outlines of the history of geography and the chief discoveries, instruction in the use of methods of illustrating geographical teaching with the aid of astronomical apparatus and diagrams, specimens, models, ordinary and relief maps, pictures and diagrams, a knowledge of drawing, the faculty of observation in the field, and the art of teaching. The educated classes can only attain that good geographical knowledge which is of such great practical value to them by the Universities doing their part in providing a sound geographical training to intending teachers.

Mr. A. J. Herbertson followed with a paper "On Geography in Secondary Education and the Training of Teachers therein." While the elementary school teacher usually receives some geographical instruction in the training college, the secondary schoolmaster in our country rarely has any. It therefore follows that the artizan classes have a better geographical education than those classes to which geography is of much greater practical importance. The first step to be taken to remedy this deplorable state of affairs is to train the teachers for our secondary and higher schools, and to give geography a standing as a degree subject in our Universities; and Mr. Herbertson suggested that a resolution be passed to call the attention of Government and University authorities to it, to ask for the adequate recognition of geography in higher schools and colleges, and the proper provision for satisfactory instruction both in secondary schools and Universities.

In a paper by Dr. Henkel (which was taken as read) "On the Combination of Geography and History in the Curriculum of Modern Schools," illustrations of the intimate connection of geography and history were given from both ancient and modern nations, of which Great Britain furnishes the most fertile and characteristic material. Great Britain owes its greatness to the physical basis of the ocean, as was the case with Ancient Greece, and offers a great contrast to the political life of Asia. Insular conditions were greatly assisted by Magna Charta. The nation has a thoroughly Germanic character, and offers a striking contrast between rich and poor. The mountains of Scotland have been of great historical importance to that country, while its oceanic climate has greatly affected Ireland. The rivers of Great Britain have facilitated marine intercourse. Thus everything conduced to the material development of a great maritime power culminating in the eighteenth century, and assisted at a later period by mineral wealth, steam, and industry.

Mr. Mackinder advocated the establishment of a central school of geography in London, and Mr. Hooper spoke of the work done by the London Chamber of Commerce. Chief Justice Daly, Prof. Levasseur, Prof. Lehmann, Mr. Mackinder, and Mr. Herbertson were appointed a committee to prepare a resolution to be submitted to the Congress.

PHOTOGRAPHIC SURVEYING.

"The Application of Photography to Mapping" was the title of a paper by Colonel Laussedat, which described the processes and instruments by means of which surveying had been successively practised by the Greeks, the Arabs, the Spaniards and Portuguese, and by the Dutch. The "Dutch Circle," evidently derived from the Astrolabe, came to transform the arts of geodetic and topographical surveying. By the invention of the "Pretorian Table," round the centre of which moved an "Alhidade," the method of triangulation soon became general. The vernier, the cross wires in the telescope, the spirit level, the perfecting of dividing machines, the theodolite, the filiar micrometer, and the stadia, have all contributed to the ease and accuracy of surveying. Topographical sketching was greatly used in ancient and mediæval times, and during the sixteenth and seventeenth centuries "bird's-eye views" of towns, harbours, castles, etc., were generally used in place of maps, and great artists executed views of cities, sieges, and battle-fields, which were excellently engraved. The method of horizontal sections, first introduced in France, may be mathematically accurate if a sufficient number of points are included in the levelling operations, and for this purpose the use of photography would be a quick method. The views would be available for subsequent reference, and as guides in the construction of horizontal sections, and in addition they have the incomparable advantage of rendering the different aspects of the land surface features, and thus form a picturesque complement to the general plans. M. Déchy insisted on photography being only an auxiliary to triangulation, and Mr. Coles informed the section on the subject of his map constructed from photographs of the Caucasus, in which region surveys have been conducted by the aid of photographs and prismatic compass readings.

Captain E. H. Hills, R.E., then read a paper "On the Determination of Terrestrial Longitudes by Photography." Following Dr. Runge's method, in which instantaneous exposures were made of the moon, and the reference stars were allowed to impress their trails on the plate, a better method of measuring and reducing the plate was adopted, and a more suitable camera employed. The method of reduction used was that of rectilinear co-ordinates, which had been worked out by Prof. H. H. Turner for reducing the plates of the International Photographic Star Chart. The longitude can be obtained from one photographic plate with an error of about one second of time.

The last paper of the sitting was by Prof. J. Thoulet, "On the Application of Photography to Oceanography." The shifting and changing sandbanks along our coasts are such a danger to navigation that it would be of great use to possess plans of them at given times, and under given conditions. This can be accomplished by means of photography during a single low tide, either from the land or on board a vessel, even in motion. Any camera can be used, and it is only necessary to know its focal length, and to photograph along with the object of survey a point of known elevation and known azimuth.

Subsequently Mr. Coles described Colonel Stewart's camera for producing photographs of the whole horizon, and M. Janet spoke on the determination of longitudes without instruments of precision.

ANTARCTIC EXPLORATION.

The question of Antarctic exploration was opened by Dr. Neumayer by an elaborate paper "On the Scientific Exploration of the Antarctic Regions," in which, after reviewing the history of Antarctic exploration in the past, he insisted on the scientific necessity of a new exploring expedition, with aims similar to those of Sir James Ross. The climatology of the globe could not fail to be advanced by an expedition that remained within the Antarctic Circle

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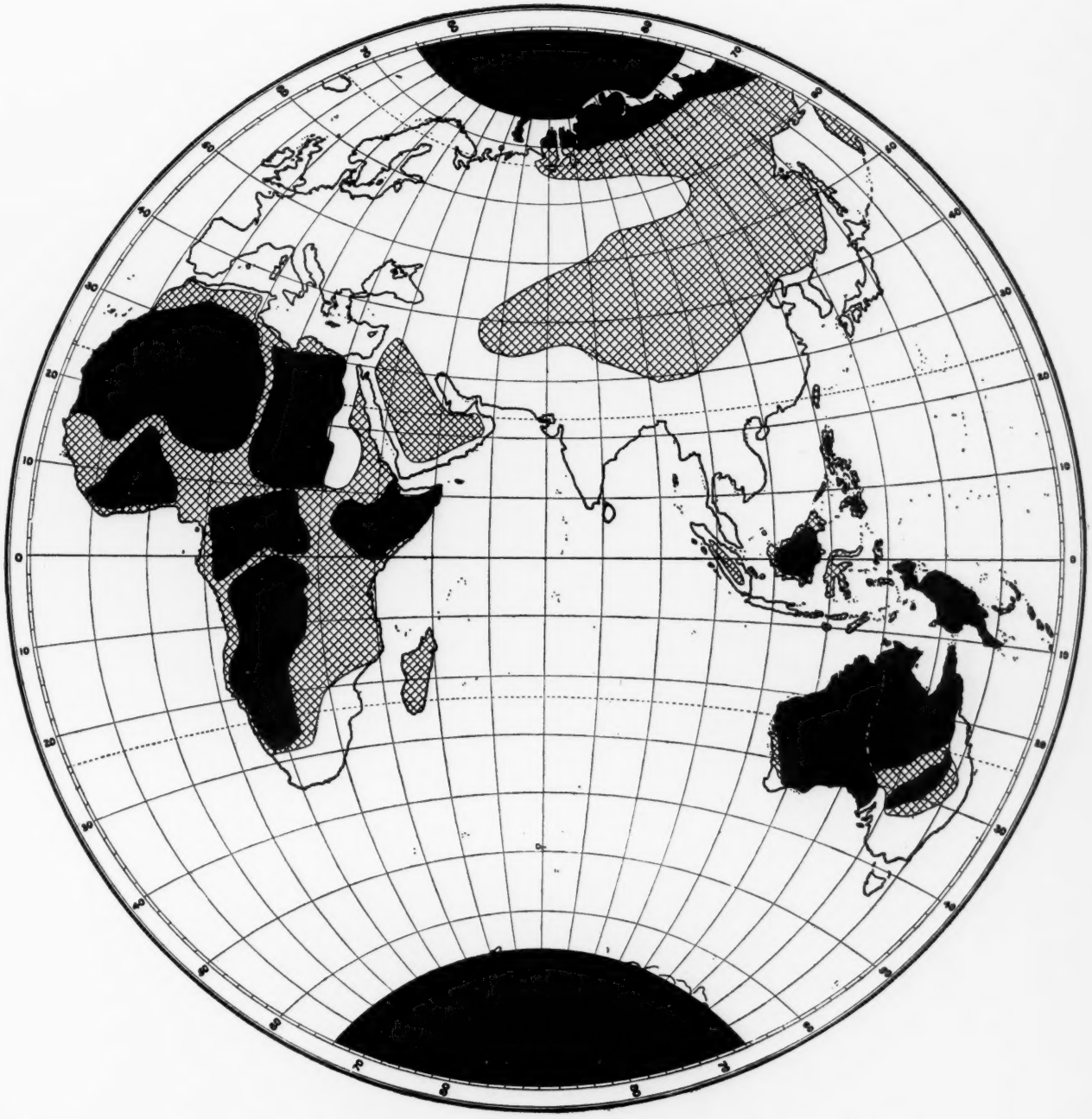
SKETCH MAP OF THE WORLD ILLUSTRATING THE EXPLORED (WHI PARTI

The above Map, in illustration of the article "On the Exploration of the Surface of the Globe," in the August number of KNOWLEDG nded to
areas of both land and sea that either have never been traversed, and are therefore altogether unknown, or have been but slightly explored by a fe
travel, trade, and occupation by more or less civilized and organized governments, but not thoroughly explored. The spaces left blank lands ar
geodetically. As these areas gradually merge into each other, their boundary lines on the map are not intended to be regarded as ces of de
square miles are as follows:—Africa, 6,500,000 ; Australia, 2,250,000; North and South America, 2,000,000; Asia, 250,000; Islands, 500,00 Region



(WHITE), PARTIALLY EXPLORED (SHADED), AND UNEXPLORED (BLACK) REGIONS.

OWLEDGE.—Added to show the amount of exploration yet required to make known the entire surface of the earth. The spaces in black represent the explored by a few journeys which have given the physical features of route lines only. The shaded spaces indicate regions generally known by blank sh lands and seas which have been well explored, though some include large districts that have not yet been accurately mapped or surveyed ed as p es of demarcation, but only, except where they coincide with coast lines, as general approximations. The areas of unexplored regions in , 500,00 Regions, 3,500,000; Antarctic Regions, 5,000,000; or a grand total of 20,000,000 square miles.—J. Logan Lobley.

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during the winter. In Germany the advantages and practicability of Antarctic exploration have been discussed by eminent geographers, who are agreed as to its high scientific value; that amongst the sciences to be benefited, terrestrial magnetism occupies the most prominent position, and that the establishment of a magnetic observatory in the Antarctic regions for twelve or eighteen months would be of great service to science; but that if there were simultaneous observations in both Polar regions the best results would be obtained. Dr. Neumayer gave a brief account of the calculations he had been engaged in during the last ten years, to show the necessity for a magnetic survey of the Antarctic regions. A gravity survey and pendulum observations would furnish geodetic data of the greatest importance. The study of glacial phenomena would, too, be advanced by further knowledge of the southern ice-cap, and the causes of the variability of geographical latitude would probably be elucidated by Antarctic phenomena, while zoology would be advanced by further knowledge of the animal life of the southern seas. The route to be taken ought to be along the meridian of New Zealand, or near the meridian of Cape Horn, or near the meridian of Kerguelen Island. The last-named route was resolved upon in April last by the Antarctic Committee of the "Geographentag" at Bremen. The author, in conclusion, hoped that the grand example set fifty years ago by the British, French, and American nations may be followed, and that three expeditions may be simultaneously started on each of the three routes he had named. This might result in one of the most noble achievements of modern times.

The President, after expressing an opinion in favour of a combined effort of nations, called upon Sir Joseph Hooker, the only survivor of Sir James Ross's expedition, who considered that in a new Antarctic expedition special attention should be given to terrestrial magnetism, meteorology, and fossils.

Dr. John Murray supported a new expedition, for it would add to our knowledge of the physics of the earth. Victoria Land, he thought, was a real Antarctic continent and not a series of islands. Gneiss and other continental rocks were dredged by the *Challenger* in its seas, and whalers brought Radiolarian ooze, etc. There was a low barometer all round the Antarctic, indicating it to be an anti-cyclonic area. Life was more abundant at one thousand fathoms than in any other seas; one hundred species had been taken on two occasions, and these had included large animals, and sixty per cent. were not found elsewhere. He concluded that a littoral fauna had been driven down into deep water by surface currents. There was a great death of surface fauna which formed the food of the bottom fauna. All civilized nations should co-operate before the close of the century, and Great Britain should lead. There should be a preliminary survey of the exterior of the region, and then observatories should be established for two winters, to be visited in the summer.

Sir George Baden Powell, M.P., spoke of the increase of the trade of the southern seas requiring a better knowledge of their currents, etc. He thought he could pledge the new Parliament to face any necessary expenditure, and Australia would help. He hoped a new Antarctic expedition would be the crown of this Congress. The discussion was continued by M. de Lapparent, General Greely, and others. M. B. de la Grye, M. de Gregorin, Sir Joseph Hooker, Dr. John Murray, Prof. Neumayer, Lieut.-Col. de Shokalsky, and Prof. Von den Steinen, were appointed a committee to prepare a resolution in favour of Antarctic exploration.

ARCTIC EXPLORATION.

On the subject of Arctic exploration Admiral A. H. Markham read the first paper, the object of which was to briefly survey the threshold of the unknown region within the Arctic Circle. The routes by which this unknown region might be approached were (1) Smith Sound, (2) Jones Sound or Wellington Channel, (3) Spitzbergen, (4) Franz-Josef Land, (5) New Siberian Islands (6) Behring Strait. Our knowledge of Spitzbergen we owe to Hudson, Sir E. Parry, Leigh Smith, Gilles, and Tobiesen. It was safe to approach from the action of the Gulf Stream, and the ice to the north was smooth but moving south. Franz-Josef Land, discovered in 1872-73 by the drift of the "Tegethoff," and visited in 1880-81 by Mr. Leigh Smith, is probably a large land area, and so with its good harbours for wintering ships is a promising route and had been adopted by the Jackson-Harmsworth expedition. Its western shores should be first explored. The route of the New Siberian Islands taken by Nansen was not approved, as Admiral Markham doubted the theory of that intrepid explorer. These islands were, however, highly interesting from their fossil trees and bones of mammoths. The old Greenland route was adopted by Lieut. Peary, whose safety was now in doubt. Each nation should undertake the exploration of a certain portion of the Arctic regions, and the results of such a combined effort would be for the advancement of physical geography, geology, ethnology, zoology, meteorology, and oceanography.

General Greely, in a paper "On the Scope and Value of Arctic Exploration," after referring to its difficulties, pointed out the commercial, scientific, and missionary results of further exploring work in the Arctic regions, and concluded an eloquent address by an appeal to Britain to continue its great work.

M. S. A. Andrée then brought before the Congress his project for reaching the Pole by means of a balloon. To achieve this result the following requirements ought to be fulfilled:—(1) The balloon should be of sufficient carrying power to enable it to carry three persons, together with all necessary instruments for making observations, provisions, etc., for four months, and ballast, all estimated to weigh about three thousand kilogrammes. (2) The balloon should be of such impermeability that it can be kept afloat for a period of thirty days. (3) The filling of the balloon must take place somewhere in the Arctic region. (4) The balloon should be steerable to a certain extent. The question, then, to be put to an aeronautical engineer is, Can this be done? He will be justified in answering, Yes. M. Andrée showed from practical experiments that his requirements 1, 2 and 3 could be obtained, and he had himself by means of a steering apparatus caused his balloon, "Svea," of one thousand cubic metres, to deviate, on an average, 27° from the direction of the wind. This was effected by providing the balloon with an adjustable sail, and one or more guide-ropes, which are allowed to drag on the ground. The balloon is thus made to move with less velocity than the wind, and this difference is utilized by the sail. The balloon will be balanced to travel at an average height of two hundred and fifty metres above the surface or below the lowest clouds, but above surface fogs. Continual daylight, rapidity of travel, uniformity of temperature, an unencumbered surface, little snowfall and absence of thunder-storms, render success in reaching the Pole, with a steady favourable wind, highly probable.

Admiral Markham objected that, even if such a plan were successful, it would be confined merely to getting to the Pole, and would not give surface facts. Colonel Watson testified from Aldershot experiments and practice that

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balloons can be made to hold gas for a lengthened time. The Arctic regions were better adapted for ballooning than any other area, from the uniform temperature and continuous daylight. General Greely opposed the project as being too risky. The balloon might get to the Pole, but how was the party to return with prevailing southerly winds? He doubted if the balloon could live more than three or four days. In his reply, M. Andrée said that he had tested his plan over a large region, and stated that the required funds had already been placed at his disposal.

A paper by Mr. E. Payart advocated as a preliminary measure the extension of telegraphic communications as far north as possible, towards advanced points that might be adopted as starting stations by different simultaneous expeditions resulting from international action, which would do more effective work in a couple of years than would be accomplished by a large number of successive expeditions. This was followed by a paper "On Russian Researches on a Sea Route to Siberia," by Lieut.-Col. Shokalsky.

PHYSICAL GEOGRAPHY.

M. G. Lennier contributed a paper "On the Modification of the Coasts of Normandy," in which the author described the destruction of the coast that had taken place and was now going on, the cliff-falls north of the Seine estuary, the cliff-falls south of the Seine estuary, the destruction of rocks by marine animals, and the modification of the coast-line by deposits.

Prince Roland Bonaparte, in a paper "On Periodic Variations of French Glaciers," after giving the history of the question, stated the methods employed as information obtained from the inhabitants of the localities; study of old plans; using simple points of reference, by the aid of which the distance to the glacier is measured as frequently as possible; the placing of lines of stones at the foot of the glacier, the plan of which is prepared geometrically; the annual construction of a complete geometrical plan of each glacier. Upwards of two hundred glaciers in the French Alps were under observation, and the conclusion arrived at was that most of these glaciers are shrinking, but that a tendency in the opposite direction is beginning to manifest itself in many places. The author concluded by a reference to the possible relations which may exist between these variations and general atmospheric conditions.

Papers on the measurement of time and angles were presented.

GEODESY.

General J. T. Walker read a paper "On the Geodetic Operations of the Indian Survey," which described the great triangulation of India, by which the lengths of the arcs are determined; the astronomical operations for the determination of the latitudes of some of the stations of the survey; and the electro-telegraphic operations for the determination of differences of longitude. The astronomical deductions are believed to be far more numerous than in any other geodetic survey. On comparing them with the corresponding geodetic deductions, it is found that large deflections of the plumb-line are met with, and frequently in places where there is nothing visible on the surface of the ground to indicate causes of deflection, and where the cause must therefore lie in variations of density in the strata beneath the ground-level. Excluding all places obviously affected by Himalayan attraction, there are one hundred and forty-eight astronomical latitudes, which have been combined into nine groups, presenting eight meridional arcs of amplitude extending from lat. 8° 43′ to lat. 30° 9′, with amplitudes ranging from 2° 23′ to 3° 88′, and increasing with the magnitudes of the local deflections apparently affecting the arc. For the longitudinal arcs, four have been formed on the parallels of 12° 58′, 17° 42′, 23° 36′, and 28° 22′, by combinations of the original arcs. The eight meridional and the two central longitudinal arcs are believed to be the most valuable contribution to geodetic science that has ever yet been made, and the result of operations carried on in India for a period of over ninety years.

A paper was then read "On the Desirability of a Geodetic Connection between the Surveys of Russia and India," by Colonel Holdich, who proposed, with the co-operation of Russia and Persia, the negotiation of three arcs: (1), between the Indus and Charban, on the Persian coast, a longitudinal arc; (2), between Charban and Mashad, a meridional arc; and (3), between Mashad and Teherán, a longitudinal arc. The first of these would be about four hundred miles, the second six hundred miles, and the third four hundred miles, all of them through country most favourable for triangulation.

M. Lallemand presented a paper "On the General Levelling of France," giving an account of the new survey operations commenced in 1884, to replace that of Bourdaloüe in 1860. From 1884 to 1892 a fundamental network was laid down, extending to a distance of twelve thousand kilometres in length, comprising twenty thousand fixed points, and attaining a degree of precision three times as great as that attained by Bourdaloüe.

Papers on the geodetic survey of South Africa, by A. de Smidt and Dr. David Gill, were also read.

(To be continued.)

THE NEWLY-FOUND RACE IN EGYPT.

By J. E. Quibell, *of the Egyptian Research Account.*

FOR years past certain mysterious classes of objects have been offered for sale in Egypt by the dealers. They had never been found by European excavators, though the number of places at which they were offered—Gebelên, Silsileh, Abydos—showed that they were fairly distributed over Upper Egypt. No date could be assigned to them, for no one had ever observed the position in which they were found or what objects of known date were above or below them.

Whether they were Egyptian or foreign in origin, whether they were due to one people or to several, no one could say. During the past season, however, several of these classes of objects have been proved to belong to a race of foreigners, whose existence had not been suspected, and the date at which these people overran Egypt has been determined. When Prof. Petrie's private work and the excavations of the Research Account began last December near Ballas, attention was at first directed to a large cemetery of early Egyptian period. This proved to have been entirely plundered by the dealers, largely within the last few years. A town mound, the bricks of which bore the stamp of Thothmes III., was examined and found to be the Ombos mentioned in a famous passage of Juvenal. The temple of the town was exhaustively cleared and planned.

And then came the great discovery of the year.

Half a mile back in the desert some circular depressions, an inch or two deep and a yard wide, were noticed. Men were set to dig. They cut down into graves, indeed, but rifled ones. Trials were made near them, and other graves were found. Then the remarkable fact was observed that the bodies were not buried at full length, as the native Egyptians always were, but in a contracted position. The body lay upon its left side, with head south and face west;

the hands were in front of the face, and the knees were drawn up to the elbows. Tomb after tomb was opened, and the position of the body was always the same. It was clear that we had to do with some non-Egyptian people. Soon a better class of tomb was found, with pottery grouped round the body. The pottery was mainly of two types; a black and red smooth-faced ware of simple and well-shaped forms, and a coarser variety with wavy ledge handles. Neither of these was known to be Egyptian. The red and black pots had been often seen in dealers' hands, but to what period they should be attributed was not known. Those with handles we did not know in Egypt, but fragments of similar vases had been found in Palestine, at pre-Judaic levels, by Prof. Petrie, and had been attributed to the Amorites.

Slates, too, were found, often shaped to resemble a fish. These were always placed in front of the face; sometimes they retained stains of green, and near the slate would be a smooth brown pebble, also with a trace of green. The green was malachite, and the slates seemed to be palettes for grinding face paint.

These slates, again, were well known—specimens had been often bought from dealers, and are to be found in various museums, but they are labelled merely "from Egypt"; whether they belonged to natives or to foreigners, whether they were made in 4000 B.C. or 400 A.D., was totally unknown.

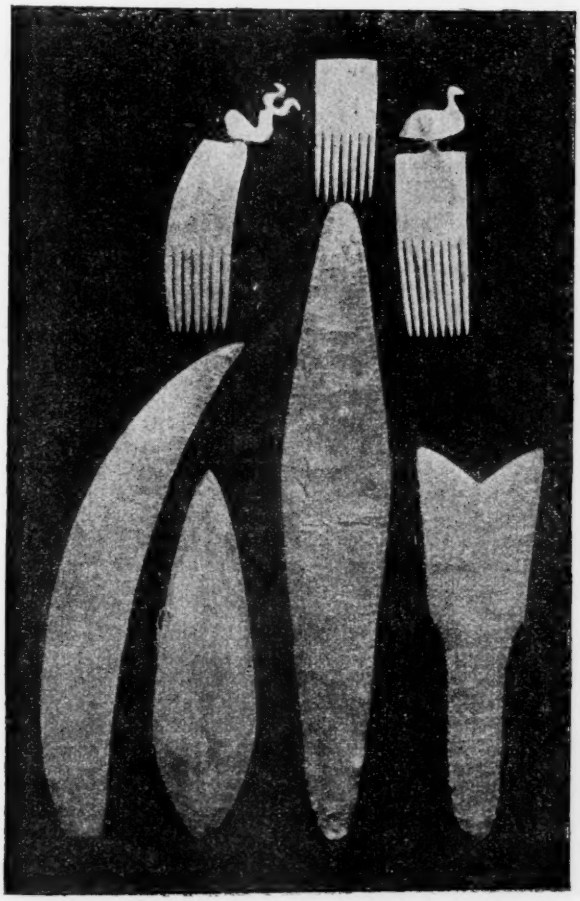

FIG. 1.—Finely worked Flints and Ivory Combs made by the newly-found Race.

Two more classes of objects were found which had hitherto been unobserved *in situ* by any European, viz., stone vases with horizontally pierced handles, and flints of exceptionally beautiful workmanship. These last are the finest specimens of such work known in any age. The flaking is of machine-like accuracy and precision, surpassing even the finest Scandinavian examples. The use of the fish-tailed shape (*vide* Fig. 1) can only be guessed. It was attached to a wooden handle and used perhaps for spearing antelopes.

The size of the tombs varied considerably. Some were but two feet deep and barely large enough to contain the crouching body and a single vase, while others were fifteen feet by eight, and eight feet deep, and contained as many as eighty pots, besides small objects, stone vases, beads, or flints.

Most of the pots were empty, but certain large coarse jars were filled with ashes. Ashes of what? For the bodies were not burnt. No sign of fire was on the bones.

Other jars were found containing mud. This was very puzzling until one of the lumps of mud was found to smell strongly, and then another was discovered with some aromatic fat under the mud, then another with pure fat. The mud had been, no doubt, an audacious adulteration or a pious substitute. This fat seemed to smell of cocoa-nut, but it has been proved on analysis not to be cocoa-nut oil, though what it is has yet to be determined.

They must have been a tall and powerful race, as is apparent from the great thickness of their thigh bones and their massive jaws. In the early part of their sojourn in Egypt mutilation of the dead was certainly practised by this newly-discovered race. Of the first eight hundred graves cleared, only two contained bodies with skulls attached. In all the other cases the head was either missing or more usually detached from the body and lying at a higher level than the rest of the skeleton. It is possible that the head was removed on death and kept in the house for a year, as is the practice to this day with some races, and afterwards, if it could be found, it was buried. But there is no sign of mutilation in some of the later graves; and the body is strangely dried and the flesh wonderfully preserved, as may be seen from the skull depicted in Fig. 2. The hair and part of the scalp is still attached, while the dried ear may be plainly seen. The tendons, too, were so strong that a body could almost be lifted out from the grave entire. This points to a change in burial customs during the residence in Egypt.

Altogether nearly three thousand graves were cleared and recorded. In this work a man and boy were always employed together. The man digs with a kind of adze, and fills a basket, which the boy carries and empties. When the bones and pottery appear the adze is laid aside, and with a broken potsherd the man carefully clears away the remaining gravel, leaving each bone and object in its place, but clearly visible. Then the observer comes, and, standing above the tomb's edge, sketches what he sees, descending usually to clear something more completely with his own hands. Then he marks with the tomb number every object which has to be kept, and sometimes even himself packs the men's baskets that all the finds may be safely carried to the hut. A single observer can thus clear and record with some care about eight tombs in a day. In the two sites together, those of Prof. Petrie and of the Research Account, there were generally four observers employed, and the stack of skeletons before the doors of the hut and the regiments of pots which stretched out in front of them grew rapidly.

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One great question set before us was to determine the date and origin of this newly-discovered race. They were clearly foreigners—their contracted burial, and the absence

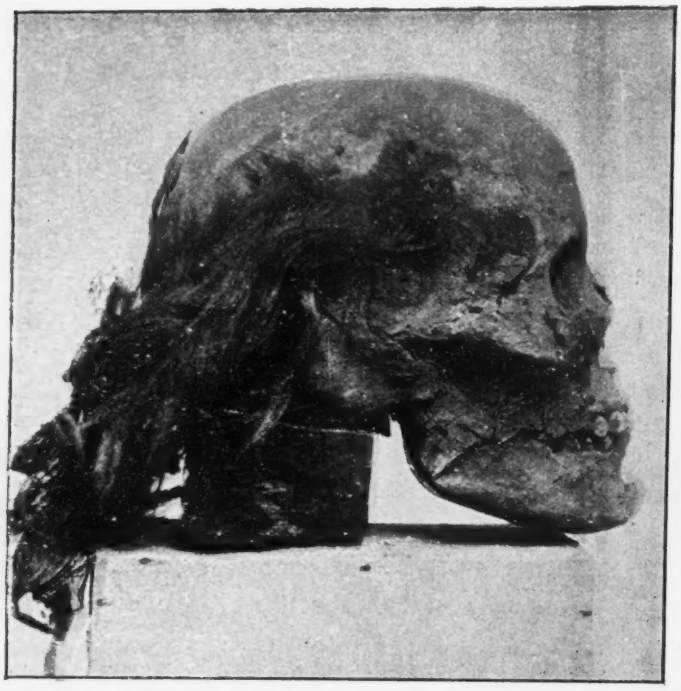


Fig. 2.—Skull of one of the newly-found Race, with hair and ear still attached.

of all purely Egyptian objects proved this; that they must have lived in the country in great numbers, the size of the cemetery showed. They must also have lived there for a long period, for the gradual change of fashion in the shapes of vases could be seen as we dug from the older into the later graves. Into what period of Egyptian history could they fit?

The only way in which this could be discovered was by finding Egyptian objects of known date in graves or towns of the new people, or objects of the new people in Egyptian ruins. A careful watch was kept, but no scarab or scrap of pottery of Egyptian manufacture was found in any of the new graves. A small Egyptian temple was cleared out. Pottery and bricks known to be of the XVIIIth Dynasty were found on the surface, underneath them were found sherds known to belong to the XIIth; underneath still further were more walls, and lying against them pottery known as belonging to the IVth. And in all this mass of material no scrap of the new pottery—no fine flints—no trace of our new people was to be seen!

Three hundred yards away was the site of the foreigners' town. It, too, was excavated; the new types of pottery were found in abundance, but as in the graves, nothing Egyptian.

A third town, three miles north of the first, again belonging to the foreigners, was examined, and it was found that after the town had been ruined, the heaps of bricks and mud had been found convenient places for burial, and Egyptian full-length graves had been dug in it. The graves contained no dated scarabs, but numbers of vases of a peculiar drop-like shape and of straw-coloured clay. The shape of the vases made us suspect them to be of the Middle Empire (the XI—XIV Dynasty) and this suspicion was confirmed when at some distance was found a single burial containing two of these same vases and a necklace of beads of undoubted Middle Empire patterns. The graves then dug in the ruins of the town of foreigners were of the Middle Empire, and the dominion of the new race must belong to some period anterior to this—either to the dark period between the Old Empire and the Middle, or to the pre-Egyptian period altogether, for during the Old Empire the power of the Egyptians was too well consolidated for any great tribe of foreigners to have existed in the country.

This question, too, was fortunately solved, for at one point in this long, tomb-strewn stretch of desert was another small cemetery, plainly of Egyptian origin. Almost every tomb had been robbed by dealers within recent years, and lay open. The tombs were of an unusual kind, entered by sloping staircases cut in the rock, but fragments of turned alabaster dishes and potsherds of a well-known type proved that they had been made by Egyptians of the Old Empire. Some of the graves had been robbed in ancient times, perhaps only a few score years after their making, and in the soft soil which soon accumulated in the open grave a man of the new race had been interred. He was buried, then, in an Old Empire grave; the invasion of the foreigners must, therefore, have taken place after the Old Empire's fall, at the close of the VIth Dynasty. Perhaps even it occasioned that fall, and we should thus have an explanation, if not entirely a satisfactory one, of the extraordinary and entire separation of the remains of the two races.

The new people must have invaded Egypt at the close

Fig. 3.—Vase, painted with a design of a ship.

of the VIth Dynasty, say 3300 B.C., and crushed the pyramid builders. They must have swept out the Egyptians

from Upper Egypt with a terrible thoroughness, and have lived there for several hundred years in their own way, hardly trading at all with their Egyptian neighbours. Then when, under the Antefs and Mentuheteps, Egypt again rose to strength, the foreigners were expelled, though not with quite the same thoroughness as they had themselves used in expelling the Egyptians.

The foreigners did not write. Many scratched marks were found on the pottery, but they were merely marks of ownership, and do not show any alphabetic arrangement. No record of them is preserved in Egyptian. Their memory had been entirely lost for five thousand years, until the fortunate results of one season's digging brought them again into light.

One great question remains. Who were these foreigners, and whence did they come—east, west, north, or south? Not from the south; for in their skulls there is no trace of a negro type, and they obviously knew the sea, for on one of their rarer types of vase, as will be seen in Fig. 3, is painted the design of a ship. It is more likely that they came from the west, and were Libyans from North Africa, who passed across the desert, taking the oases on their way, and then struck into Upper Egypt.

FIG. 4.—Tattooed Female Figure.

Little is known of the ancient Libyans. Little has been known till of late years of the Kabyles, who are their descendants. But they were an important people even in the days of Khafu, and Libyan archers with top-knots of ostrich feathers were well known to Egyptians of that day. In the XIIth Dynasty, Usertesen I. fought a campaign against them; in the time of Rameses III., so late as 1200 B.C., they had again crowded into Egypt and were by him expelled. They were an important and powerful people.

A number of arguments point to the new race being identical with this people, and nothing known is inconsistent with the idea. On the tomb of Seti in Biban el Moluk some Libyans are represented; they have white skin and are tattooed. Now in one of our graves was a small tattooed statue of a woman, a photograph of which is reproduced in Fig. 4. Again, the fine pottery of the new race is hand-made and was not made on the wheel. Rather good pottery is made by the Kabyles of to-day, built up by hand without the wheel, and the shapes and decoration of this modern pottery recall in several points that of the new race. This point will be settled by further study, and when the measurements of the skulls are completed and compared with any measurements of Kabyle skulls that we can find, a good test of the identity of the race will be afforded. As a working hypothesis, we may at any rate say that it is the Libyans who have been discovered in Egypt this year. It is much to be desired that a search will be made for traces of this people in the oases and in North Africa, and that a careful study will be made of their modern representatives, the white populations of the interior of Tripoli and Algeria.

WIND-FERTILIZED FLOWERS.

By the Rev. ALEX. S. WILSON, M.A., B.Sc.

AS an agent in cross-fertilization, the wind performs an indispensable service to many plants. Flowers which depend on its agency for the transport of their pollen are termed anemophilous; those adapted to insects, entomophilous. Wind-fertilized blossoms are all of small size, obscurely coloured and, even when clustered together in catkins, inconspicuous; hence they escape observation more readily than their entomophilous neighbours, which are adorned with bright colours to allure visitors. Although anemophilous flowers do not exhibit the variety of curious contrivances found in the entomophilous class, they yet present a number of highly interesting characters and are well worthy of examination. Wind-fertilization is universal in the lower or gymnospermous division of flowering plants, of which we have examples in the pine, larch, cedar, and other coniferous trees. The apetalous dicotyledons or Incompletæ form another large group in which wind-fertilization prevails extensively. In this sub-class are included the various

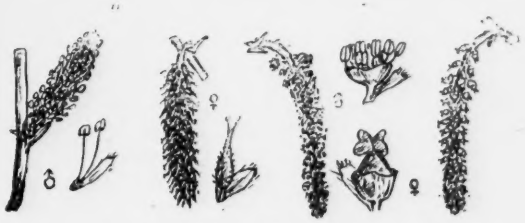


FIG. 1.—Catkins of Wind-fertilized Flowers. A, Willow; B, Poplar. (Diœcious.)

species of dock, sorrel, nettle, pellitory of the wall, dog's-mercury, goosefoot, boxwood, hop, mulberry, elm and catkin-bearing trees such as the oak, hazel, beech, poplar, birch, alder, walnut and willow, all of which are wind-fertilized. Anemophily is not so common in dicotyledons

belonging to the other sub-classes; it occurs, however, in the ash, plantain, wormwood, mare's-tail and meadow-rue. The number of wind-fertilized monocotyledons far exceeds those adapted to insects, both as regards individuals and species. The extensive order of grasses, the sedges, carices and rushes, together with the arrowhead, arrowgrass, bur-reed and bulrush, are all without exception anemophilous. It thus appears that wind-fertilization occurs in many different and widely separated families. Certain negative characters are common to all the wind-fertilized class; no honey is secreted, no perfume emitted, and conspicuous colours are wanting. On flowers of this description it is difficult for a large insect like a bee to obtain a footing; there is no corolla that can serve as a landing-stage for insects to alight. For these reasons anemophilous blossoms are almost entirely neglected by bees and other flower-haunting insects; only in exceptional instances do visitors have recourse to them in search of pollen, but this is so dry and has so little cohesion that it must be difficult indeed for a bee to collect an appreciable quantity of anemophilous pollen. Wind-fertilized flowers thus offer little or no attraction to insects, and are in no way adapted to derive benefit from their visits. On the other hand, there exist in them a number of provisions which admirably adapt them for cross-fertilization through atmospheric agency. The most important of these is abundant pollen; always more than in insect-fertilized blossoms, the quantity produced by some plants of the wind-fertilized class is enormous. The so-called showers of sulphur, occasionally reported in the newspapers, are really great deposits of pollen blown from the male cones of the Scotch fir. It has been known to fall on ships at sea, and has been swept up in bucketfuls from their decks. The common ash discharges an immense quantity from its innumerable flowers, so much so that a person shaking a branch when the tree is in bloom is dusted from head to foot with the dry powdery pollen. That of the elm is also very abundant, and this is more or less characteristic of all plants which depend for cross-fertilization on the wind. At certain seasons the air may be said to be literally charged with the pollen of anemophilous plants. In the beginning of May I exposed on the window-sill for forty-eight hours a microscopic slide smeared with syrup, and on examining it afterwards detected upwards of fifty pollen-grains belonging to various trees, some of which are not to be found within a radius of two miles. The efficiency of the wind as a fertilizing agent is, therefore, much greater than one might suppose.

Fig. 2.—Pollen Grains of Insect- and Wind-fertilized Flowers. 1, Coltsfoot; 2, Abutilon; 3, Wolf's-bane. (Insect-fertilized.) 4, Hazel; 5, Ash; 6, Plantago; 7, Grass; 8, Pine. (Wind-fertilized.)

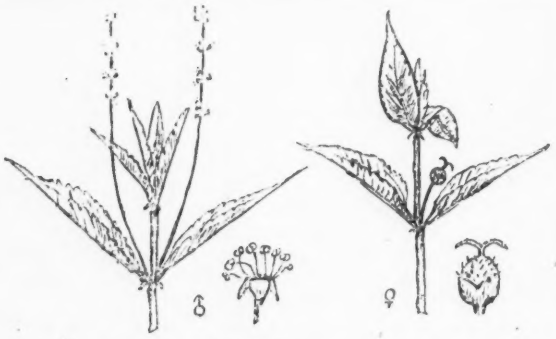


Fig. 3.—Male and Female Plants. Dog's-Mercury.

The pollen grains of insect-fertilized flowers are frequently, as in the harebell, coltsfoot and mallow, studded over with little projecting points; these cause them to adhere readily to each other or to the hairs of an insect. In other cases the pollen is viscid, and the granules are difficult to separate. This cohesive character obviously renders them ill adapted for transference by means of the wind; accordingly the pollen of wind-fertilized plants is excessively light and dry, the granules are smooth, they do not stick together, and this incoherence facilitates their wide dispersion. A special provision exists in the pine, whereby its pollen is rendered lighter and more easily wafted by the wind; the extine or outer membrane of each granule is inflated into two globular air-sacs, which reduce its specific gravity so that it can keep longer afloat in the air.

Although there are wind-fertilized species to be found in bloom almost all the year round, a large number, especially of trees, blossom early in the season; the hazel comes into bloom in February, the elm, poplar and willow following in March or April. The little flowers of the willow are already developed within the bud at the beginning of winter; in spring they merely expand. It is, therefore, probable that trees of this class originally flowered towards the end of the year, but ultimately became so belated that the opening of their flowers had to be delayed over winter. During the dry, windy days of spring, when the farmer sows his seed-corn, the flowers of our anemophilous trees are in perfection. At this early period, when so few insects are abroad, these unattractive blossoms are not likely to be favoured with their visits.

Fig. 4.—Inflorescence of the Quaking Grass.

A marked peculiarity of anemophilous trees is the appearance of the flowers before the foliage; the blossoms of the elm, poplar, ash and willow, for example, are put forth while as yet the branches are entirely leafless. This arrangement is clearly advantageous; the foliage would protect the flowers from the wind, preventing it from gaining access to the stigmas and interfering with the removal of the pollen.

The fir does not shed its leaves in autumn as deciduous trees do, but its needle-like foliage interferes as little as possible in the way indicated; nevertheless, the male and female cones are developed on the branches of the fir in the most exposed positions. A good illustration of the manner in which wind-fertilized plants secure the exposure of their blossoms is seen in the dog's-mercury (*Mercurialis perennis*). This plant, common in most districts, has rather large leaves; they expand before the flowers, and would be a great hindrance to wind-fertilization were it not that the little staminate flowers are elevated on long, slender stalks which spring from the axils of the leaves and entirely overtop the foliage. The male catkin of the oak

Fig. 5.—Unisexual Flowers of Nettle.

is an inflorescence of the same description, not erect, however, but pendulous, and so flexible that it swings freely in the lightest breeze. After the flowering period, the ground under the oak, poplar, and other trees, is strewn with their male catkins; these are caducous, falling off soon after they have shed their pollen; the catkins of female flowers are necessarily persistent, though a few may occasionally be broken off by the violence of the wind.

In reeds and grasses the entire plant, being flexible, is easily shaken by the wind, and the ripe pollen is readily dislodged from the anthers; but where the stem is more rigid either the flower-stalks are slender, or the stamens have thin, thread-like filaments; or the entire inflorescence is mobile; in any case provision is made in the structure of the flower for the agitation of the anthers by the wind. Slender flower stalks are seen in the dock and in the quaking grass (*Briza*). The ribwort plantain (*Plantago lanceolata*) and a great many grasses have their anthers borne on long, excessively thin stalks, so that they quiver in the slightest breeze. Broad and leaf-shaped, the anther itself in Plantago is clearly adapted, like the seed-vessels of some crucifers, to be set in motion by the wind. On a calm and warm day in summer the gentlest touch is sufficient to make many grasses, such as the foxtail, cock's-foot or Timothy, emit a little cloud of pollen. Some grasses even appear to eject the pollen with force either by the explosion of the pollen-sacs or by a sudden jerking of the stamens. The nettle and pellitory have each four elastic stamens; when the flower opens, these are bent inwards towards the centre in a constrained position; later on, the tension is removed and the liberated stamens suddenly straighten out, scattering their pollen like little puffs of smoke. The object of this liliputian artillery is to throw the pollen away quite clear of the plant by which it was produced.

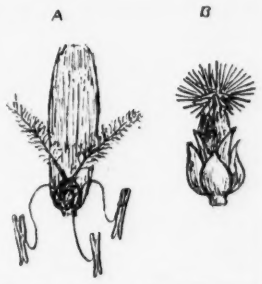


FIG. 6.—Anemophilous Flowers. A, Oat; B, Arrowgrass.

Petals in ordinary flowers are intended to secure the attention of insects; to wind-fertilized blossoms, having no occasion for visitors, they are unnecessary. So far from an advantage, the presence of a corolla would exclude the wind from the essential organs. Accordingly petals are either absent altogether, or reduced to rudimentary proportions. The calyx is also much reduced, and in some flowers is dispensed with entirely. Comparatively few anemophilous flowers possess both sets of floral envelopes. Plantago is, however, dichlamydeous, but its chaffy petals afford incontrovertible evidence of degeneration from the entomophilous condition.

FIG. 7.—Dichogamy of the Rush.

The stigma in the wind-fertilized class is highly specialized, and much larger relatively to the other parts of the flower than is the case with entomophilous blossoms. It is commonly penicillate, consisting of a tuft of hairs as in the nettle; feathery, as in grasses; or elongated and threadlike, as in Plantago and the rushes. The spirally twisted stigmas of the last-mentioned flowers are beautiful objects when examined with a pocket lens. The larger the surface which the stigma presents to the wind, the greater are the chances of pollination. Its fine fringes of papillose hairs are also well calculated to entangle the pollen-grains, while the viscid secretion serves to retain them when caught. This adaptation may be seen in the common rye grass; each tiny blossom as it expands hangs out its two white, feathery stigmas from the sides of the spikelet, reminding one of a fisherman spreading out his nets, or a sailor his studding sails to catch the favouring breeze. At the time of fertilization the dock, too, thrusts out its three little brush-like stigmas between the lobes of the perianth. It is instructive to compare these wind-fertilized flowers of Rumex with those of the nearly allied genus Polygonum, which is entomophilous. The perianth of the latter is rose-coloured; the stigmas are included within it, never exserted as in the dock—they are not at all brush-like or feathery, but in the form of little knobs; the stamens and flower-stalks are rigid; moreover, the various species of Polygonum secrete nectar and are frequented by many different insects. Stigmas are entirely absent in the gymnospermous division, but in most Coniferæ the ovule at the time of flowering secretes a drop of fluid, and the pollen-grains caught on it are, as the fluid gradually evaporates, stranded on the nucleus of the ovule. The ovule of the larch is provided with elongated papillæ, functionally equivalent to a stigma.

A flower is said to be hermaphrodite or monoclinous when, as in the elm, both stamens and pistils are present in the same blossom. With insect-fertilized flowers this is mostly the case, though there are some exceptions, such as the cucumber and begonia, which are unisexual or diclinous, stamens and pistils being produced in separate blossoms. The diclinous condition is exceedingly common in the wind-fertilized class. The staminate or male, and the pistillate or female flowers are sometimes found growing on the same individual plant, which is then termed monœcious, as in the oak, hazel, birch, pine, etc. The poplar, willow, yew, juniper, nettle and dog's-mercury, on the other hand, are dicœcious; their staminate and pistillate flowers grow on separate plants. This separation of the sexes renders self-fertilization impossible, and secures whatever benefit may arise from the physiological division of labour. Anemophilous species in general show a marked tendency in the direction of separation. Self-fertilization may be prevented in monoclinous flowers by the stamens and stigmas maturing at different times. This arrangement, known as dichogamy, occurs both in insect- and wind-fertilized blossoms, but while the former usually have the stamens in advance of the stigmas, in the latter the reverse order is much more frequent. There are thus two kinds of dichogamy—protandrous, where the stamens are in advance; protogynous, if the pistils are first developed. Protogyny is characteristic of wind-fertilized flowers, and may easily be observed in the rush and plantain. From the illustration it will be seen that, in the first or female stage of the flower of the rush, the thread-like stigma protrudes from the top of the still unopened perianth, while the stamens, as yet immature, are completely concealed. In the second stage the pollinated stigmas have begun to shrivel, the perianth has now spread out, disclosing the six stamens, which are ready to discharge their pollen. The same two stages are equally apparent in Plantago. All our readers must be familiar with the black heads of this plant, which are to

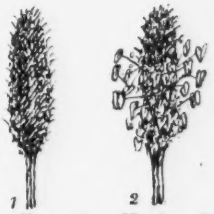


FIG. 8.—Head of *Plantago lanceolata* in two stages.

be seen on every pasture, bending and waving in the wind. In the first stage the head appears black, but on looking into it we see projecting from each little unopened floret a white thread-like stigma. Later on, the lower part of the spike or head is seen to be encircled by a wreath of tiny white bodies, and closer inspection shows that these are the stamens, four of which project like little banners from each of the newly-opened florets. The protogynous character belongs in the bur-reed to the plant itself, rather than the individual flowers. Its pistillate flowers, which are lowermost, expand first; only when their stigmas have withered do the male florets higher up begin discharging their pollen. In this case it is evident that the flowers on any plant must be fertilized with pollen from another in a more advanced condition. A social habit is highly characteristic of wind-fertilized plants—pines, grasses, sedges, nettles, etc., usually grow together in considerable numbers. Entomophilous plants have a much more sporadic character, and admit of a greater degree of isolation; their guests, doubtless, maintain the necessary communication between members of the species. This social habit partly explains the tendency towards the diœcious condition, for a complete separation of the sexes is hardly possible, except in plants of social habit. From the Gymnosperms, the oldest flowering plants, being all wind-fertilized, it has been inferred that such must also have been the case with the primitive Angiosperms. It is not certain, however, that any of their representatives remain, for many of our existing wind-fertilized flowers appear to be merely degraded forms. Anemophilous species occur in families, the rest of which are highly specialized in relation to insects. Some species of Plantago are adapted to insects; others, as we have seen, to the wind. Most of the sub-class with incomplete flowers, from which so many of our examples are taken, also exhibit striking marks of degeneration, and the same may be said of the grasses and other anemophilous monocotyledons. We also find some flowers in an intermediate condition, such as the vine and certain willows, which secrete honey and are visited by insects. Facts of this description are held by some to show that all existing anemophilous species, with the exception of the Gymnosperms, are descended from bright-coloured, insect-fertilized ancestors.

Fig. 9.—Flower of Plantago in two stages, showing protogyny.

Fig. 10.—Bur-reed (monœcious and protogynous.)

Wind-fertilization has, in some instances, been rendered highly efficient, but in any case it is far from economical, for the vast amount of pollen miscarried represents an enormous loss to plants; neither does this method admit of the same certainty and precision as the other. A wind-fertilized bears to an insect-fertilized blossom very much the relation which an æolian harp bears to a pianoforte.

Notices of Books.

Diary of a Journey through Mongolia and Tibet in 1891 and 1892. By W. W. Rockhill. (Smithsonian Institution, Washington.) The situation of Tibet, and the care with which the Himalayan passes are guarded to prevent the entrance of strangers, have combined to keep the land in comparative seclusion. Mr. Rockhill traversed a considerable section of Tibet in 1888-89, and gave an account of the journey in his valuable work on "The Land of the Lamas." His second journey, during which the diary forming this volume was kept, was made in 1891-92. He left Pekin in November, 1891, and traversed Mongolia to Kumbum, afterwards passing to Tsaidam. A difficult journey was then made from the Naich Gol to the Tengri Nor, but when about thirty or forty miles from the latter, and less than a month's travel from British India, which Mr. Rockhill hoped to reach, further progress southward was arrested by the Tibetans, and he was forced to turn his face eastward to China. He arrived at Shanghai in October, 1892, after travelling about eight thousand miles, and roughly surveying three thousand four hundred miles. Numerous observations for time and latitude, and for altitude, were made during the journey, and observations of temperature, pressure, cloudiness, wind, etc., were taken three times daily. An exceedingly interesting collection of plants was obtained, and have been identified by Mr. W. B. Hemsley. Numerous photographs were taken, some of which are reproduced in the volume, and many objects of ethological interest were brought back to enrich the collections in the United States National Museum. The publication of the results of the journey in the form of a diary is rather unsatisfactory, but let the reader be charitable, for, as Mr. Rockhill remarks, "dirt, cold, starvation and a thousand minor discomforts which beset the explorer in Mongolia and Tibet, who lives and travels like the barbarous inhabitants of those wild regions, are not conducive to sustained or successful literary work, as he may find out for himself if he will but try it."

The Time Machine. By H. G. Wells. (Heinemann.) The average writer of novels relies too often upon his imagination for his scientific facts, and by so doing presents his readers with descriptions of very unnatural phenomena. Mr. Wells shows by this fantastic story that he is not as other novelists are: he possesses a sound knowledge of science, as well as a vivid fancy, and the ability to paint word-pictures which mark him out at once as a master of exegesis. By arguments comparable to those of Jules Verne in point of ingenuity, the reader is led to believe that a machine was constructed to travel through time. Upon such a machine the "time traveller" journeys eight hundred thousand years into the future, and finds that society will then have differentiated into two classes, one the Eloi, a listless, diminutive class, living in idleness; and the other, consisting of horrible ghoul-like creatures, who had been compelled to work in darkness for so long that they hated the light, and only came up to the earth's surface from their underground dwellings during the night. Like the ants which have been waited upon by slaves for so long that they have lost the power of assisting themselves, the Eloi were helpless and thoughtless children who spent their lives in indolent pleasure. This differentiation of our race, based as it is upon the present state of things, and worked out upon the principles of heredity, is weird and strange to read about. Never before have the future consequences of cosmical, biological, and social evolution been described in fiction so powerfully, or with greater regard to what is known at the present time. Mr. Wells has the scientific knowledge of Jules Verne (and more so, perhaps, in biological matters), the wonderful imaginative power of Poe, and a style akin to that of Stevenson. His story of the "time-traveller's" adventures right up to the epoch when the planets begin to fall into the sun, and

after man has become extinct on an earth at a much less distance from the sun than now, does not lose interest from the beginning to the end.

A Chapter on Birds. By R. Bowdler Sharpe, LL.D., F.L.S., &c. (S. P. C. K.) This elegant, and at the same time most useful, little book certainly deserves a more elaborate title. It is indeed a series of short essays, written in a lucid and pleasantly popular style, on eighteen species of birds, which visit these islands on but very rare occasions. Dr. Sharpe is well known as an authority and writer on birds, and he has been ably assisted in the present work by Mr. Keulemans, who has depicted, in a series of beautifully coloured plates, each species about which the author writes. "A Chapter on Birds" undoubtedly fills a want in ornithological literature, for we have here collected from large and expensive works, which few possess, a great deal of interesting information about the habits and life-history of birds, in which every ornithologist must take the greatest interest, even if it is only the lucky few who cast eyes on them in this country. It is a significant fact that almost every one of the birds mentioned in this book is richly-coloured and beautiful. Why is it then, that these lovely birds do not increase in this country, and thus enrich and add brightness to our more or less dully-coloured avifauna? The reason is obvious. Any one of these birds, in common with the kingfisher and a few other gorgeous species still left to us, forms an attractive and conspicuous prize, not so much to the genuine and scientific collector, but to the man who loves to have a "pretty thing in a glass case," as Mr. Hudson so drastically puts it in "Lost British Birds," wherewith to adorn his hall. For this reason the golden oriole, "which," as Dr. Sharpe says, "might be a regular summer resident, has to be classed among our rare visitors." The beautiful bee-eater, too, "might possibly nest in England, as it has been observed in the British Islands on upwards of thirty occasions." As the nesting habits of this bird are so little known to the English naturalist, it may be worth while to give here what Dr. Sharpe has to say about them. "Like their relations, the kingfishers," he writes, "the bee-eaters adopt the method of burrowing out a tunnel in a friable sandbank. . . . . In the nest-chamber, at the end of the long tunnel, the eggs are laid on the bare soil; while gradually there accumulates a fœtid mass of fish-bones and pellets in the case of the kingfishers, and in that of the bee-eaters a conglomeration of wing-cases of beetles and the indigestible portions of the bees and wasps on which the birds feed."

The book is teeming with interesting facts, and should be added to every bird-lover's library, as an inexpensive but thoroughly reliable work.

Chemical Analysis of Oils, Fats, Waxes, and of the Commercial Products derived therefrom. From the German of Prof. R. Benedikt, revised and enlarged by Dr. J. Lewkowitsch, F.I.C., F.C.S. (Macmillan.) The German edition of this book is the best work on the chemical analysis of oils, fats, and waxes. Hitherto, no English work specially devoted to this branch of technical chemistry has been published, so the volume for which Dr. Lewkowitsch is responsible will be welcome. The opening chapters of the work deal with the constituents and the physical and chemical properties of fats and waxes, and with general methods of analysis. Afterwards follow full descriptions of all the natural fats and waxes, with methods of examining these substances and detecting adulteration, and an important section upon the technical and commercial analysis of the raw material and products of the fat and oil industries. In translating Prof. Benedikt's work, Dr. Lewkowitsch has omitted many of the tiresome details, and has introduced a large number of valuable additions, especially in the latter half of the work. As with most German text-books, little attention was given to the work of English and American chemists in the original. This defect, however, is now remedied, and every important observation made up to the time of going to press has been included. Analytical and technical chemists will not be slow in adding the work to their reference libraries, and the teacher of chemistry will find the volume a useful aid to the study of technical organic analysis.

First Principles of Chemistry. By Prof. Samuel Cooke, M.A., etc. Pp. 260. Sixth Edition. (George Bell & Sons.) *First Principles of Astronomy.* Pp. 88. Fifth Edition. (Same author and publishers.) There is nothing to distinguish either of these books from the many others of their kind. The books appear to be intended for students at the College of Science, Poona, of which Mr. Cooke is principal and professor of chemistry and geology. The illustrations are few, and what there are of them are coarse, and the text is behind the times. Lord Kelvin is named Sir William Thompson, and Prof. Lockyer is described as Sir Norman Lockyer. It seems almost a pity that Prof. Cooke did not limit the circulation of his books to the students of the Poona College of Science, for they will certainly not improve the science instruction in our schools and colleges.

BOOKS RECEIVED.

Studies in the Evolution of Animals. By E. Bonavia, M.D. Illustrated. (Constable & Co.) 21s. net.

Ice-bound on Kolguev. By Aubyn Trevor-Battye, F.L.S., F.Z.S., &c. Illustrated by J. T. Nettleship, Charles Whymper, and the Author. (Constable & Co.) 21s. net.

British Birds. By W. H. Hudson, C.M.Z.S. Illustrated by A. Thorburn and G. E. Lodge. (Longmans.) 12s. 6d.

Popular Readings in Science. By John Gall, M.A., LL.B., B.Sc. (Constable & Co.) 4s.

John Dalton and the Rise of Modern Chemistry. By Sir Henry E. Roscoe, D.C.L., LL.D., F.R.S., &c. The Century Science Series. (Cassell & Co.)

Major James Rennell and the Rise of Modern English Geography. By Clements R. Markham, C.B., F.R.S. The Century Science Series. (Cassell & Co.)

Results of the Spectroscopic and Photographic Observations made at the Royal Observatory, Greenwich, in the year 1892. Under the direction of W. H. M. Christie, M.A., F.R.S.

A Text Book of the Principles of Physics. By Alfred Daniell, M.A., LL.B., D.Sc., &c. Third edition. Illustrated. (Macmillan.) 21s.

Analytical Chemistry. By N. Menschutkin. Translated from the third German edition by James Locke. (Macmillan.) 17s.

Biological Lectures delivered at the Marine Biological Laboratory of Wood's Holl in 1894. Illustrated. (Boston: Ginn & Co.)

Pan-Gnosticism: a Suggestion in Philosophy. By Noel Winter. (New York and London: The Transatlantic Publishing Co.)

London Birds and Beasts. By J. T. Tristram-Valentine, with a preface by Frank E. Beddard, F.R.S. (Horace Cox.)

British Fungus-Flora. By Geo. Massee. Vol. IV. Illustrated. (Bell & Sons.) 7s. 6d.

Elementary Trigonometry. By Charles Pendlebury. (Bell & Sons.)

Solution and Electrolysis. By W. C. D. Whetham, M.A. (Cambridge University Press.)

An Elementary Text-Book of Mechanics. By William Briggs and G. H. Bryan. (University Correspondence College Press.) 3s 6d.

An Analysis of Astronomical Motion. By Henry Pratt. (Norman & Son.)

Easy Pieces for Translation into Latin Prose. By Geo. Carter, M.A. (Relfe Bros.)

Geographical Terms, their Derivations and Meanings. By A. W. Platt. (Relfe Bros.) 4d.

Hints on Reflecting and Refracting Telescopes. By W. Thornthwaite. Illustrated. (Horne & Thornthwaite.) 1s.

The Reality of Two Worlds. By H. I. S. Quiverfull. (Wood & Palmer.) 6d.

Catalogue of Astronomical and Scientific Apparatus. (Bolton: Banks & Co.) Post free on application.

XUM

Science Notes.

A propos of Dr. J. G. McPherson's article in last month's KNOWLEDGE on an effectual cure for snake poisoning, some very interesting facts are furnished by an Australian correspondent about snake bites during the last three months of 1894 and the first three of the present year. Of thirty attacks reported, eight proved fatal; but, strange to say, not a single death was caused by the bite of the most venomous of all the New South Wales colony (to which the facts are confined), namely, the black snake. Some of the details are instructive. March appears to be the most fatal month. All sorts of remedies were applied, and in two instances remedial treatment was actually declined, with the result that the one person died and the other recovered in a few days. If we had to hand all the facts of these two cases, it would probably be found that the different results were due to the relative quantity of the poison injected, or to the relative constitutional strength of the victims. For example, the poison of our common viper (*Vipera berus*) is undoubtedly deadly to small animals, rodents, birds, and even dogs of comparatively large size. There have been, from time to time, reports of fatal cases of adder bites of pigs, sheep, horses, cattle, and even human beings; but, as far as we know, in no case within the last quarter of a century have the "facts" been authenticated.

The Public Health Section of the British Medical Association, in its recent Congress, gave considerable attention to the subject of water filters, which has recently been much discussed in medical and scientific papers, as well as in the daily press. In the presidential address, on July 31st, it was pointed out that one of the gravest reproaches against official sanitary administration was that it was only just beginning to realize the protection which could be obtained against cholera, typhoid fever, and similar diseases, by the adoption of the Pasteur system of filtration, which had in France for many years succeeded in stamping out such diseases wherever it had been applied.

The *Chronicle* has been much agitated over the defamation of the far-famed Falls of Foyer by the British Aluminium Company, and all lovers of the beautiful in nature must feel an intense antipathy to anything that may convert, say, a Thirlmere into a Manchester reservoir. Dr. Common, F.R.S., the chairman of the Aluminium Company, assures us, however, that so far as the intrinsic beauties of these lovely falls are concerned, their utilization for the production of electricity shall be in no way damaging. The company have an unlimited supply of the mineral bauxite in their Irish workings; and at Larne the preliminary process of obtaining from this mineral pure alumina will be carried out, whilst the final electrolytic process for obtaining aluminium is to be effected by means of the electricity generated by the Falls of Foyer. The company by these means will be able to produce aluminium at about £4 a ton instead of £20 a ton. There can be no doubt that aluminium at this price will effect a revolution in many industries, and alter our conceptions as to the velocity of locomotives, steamers and velocipedes.

America is not behind the rest of the universe in showering good things on the heads of Profs. Lord Rayleigh and Ramsay. Characteristically it comes in the form of the almighty dollar. Each have received five thousand dollars from the Smithsonian Institution in recognition of their discovery of argon.

Messrs. Chapman & Hall have been constituted sole agents in this country, the Continent, and the Colonies, for the sale of the important scientific and technological publications of Messrs. Wiley and Sons, the well-known scientific publishers, of New York.

Letters.

[The Editor does not hold himself responsible for the opinions or statements of correspondents.]

THE EFFECT OF LIGHTNING ON BEECH TREES.

To the Editor of KNOWLEDGE.

Sir,—Referring to the short article on "The Effects of Lightning on Trees," in the July number of KNOWLEDGE, I venture to ask if you can supply me with any well-authenticated cases of *beech* trees being struck. It would seem that both Kauschinger and Hellman believe that there are such; but, in over fifty years of careful noting of the effects of lightning, I have never known—nor have I ever heard of any such—except once, an ill-authenticated report of one in Norway.

Inverarity, Forfar, N.B. (Rev.) PAT. STEVENSON.

[Negative evidence in a matter of this kind is of no scientific value whatever. I have examined hundreds of beech trees "struck" by lightning, and invariably the effect has been as described in my "Notes" in the July number of KNOWLEDGE. But to go beyond my own personal experience, permit me to quote a passage from an article which appeared in the columns of *Woods and Forests* (now dead), for March 5th, 1884, pp. 199-200, by Mr. John W. Crompton, of Rivington, Lancashire.

"I have frequently seen it stated that beeches are not liable to be struck by lightning. I do not find it so here; my beeches have suffered more than any other trees, oaks not excepted. The circumstance that these beeches are taller than many of the surrounding trees may have something to do with it."

Very likely, and there is no doubt at all that the water-conducting power of beech leaves, branches, and trunks, also the peculiar formation of the branches as contrasted with the square set branches of the oaks, are the cause of less damage generally being seen at the time. Since I wrote my "Notes" for KNOWLEDGE, I have had an opportunity of reading a very admirable work on the "Protection of Woodlands," by Mr. John Nisbet, of the Indian Forest Service (Edinburgh: David Douglas), which might be studied with advantage by your correspondent. Some interesting observations on the same subject will also be found in "Diseases of Trees" by Prof. Hartig, of the Munich University, an English edition of which (Macmillan and Co.) has also appeared since I wrote my "Notes." I am glad to say that these high authorities bear out the theory I advanced in my capacity of a humble field naturalist and observer.—G. W. MURDOCH.]

COLOURS OF BUTTERFLIES.

To the Editor of KNOWLEDGE.

SIR,—I have read the answers of Dr. Marshall and Mr. Johnson to my queries in your July number, but am as far as ever from enlightenment on the subject of "protective" colouring.

Mr. Johnson says—"The fact that some insects are protected while many others are not, is because those others do not need protection." What constitutes the difference between the two classes he does not say. He merely says "This is obviously a truism." I fail to see the truth in this "truism." He is bound to be more explicit. Mr. Wallace, as I formerly pointed out, expresses

his wonder that more have not been protected. *He* evidently does not consider their protection unnecessary.

Mr. Johnson still speaks of "natural selection" as "an active agent which adapts," and as "altogether an environmental force." Now I must again deny, as has been repeatedly done by much more competent authorities, that any such characters can be ascribed to it. There can be no agency, no force in mere selection. He, and other evolutionists are only deluding themselves by their improper conception, and use of a term which cannot, in any circumstances, imply what they attribute to it.

Mr. Johnson says that "all modern writers have employed the term 'mimicry' in a metaphorical sense." I am not aware that any scientific men employ metaphor when enunciating truth. Certainly neither Darwin nor Wallace so uses it.

Dr. Marshall now explains that by mimicry is meant "an accidental resemblance which is increased by hereditary transmission"; but how can hereditary transmission *increase* resemblance, the resemblance not proceeding from any cause which might accompany the transmission? And will *accidental* resemblances be transmissible at all? My experience is that they are not continued in future generations.

Dr. Marshall answers my query "What has all this to do with origin of species?" by referring me *simpliciter* to Mr. Darwin's book on the subject. Now it so happens that I have lately had occasion to study carefully both Darwin's and Wallace's books on the colouring of animals, and I have not found a single sentence in either which seeks to connect the interesting natural facts which they relate with the subject of their discussion, viz., Origin of Species. Dr. Marshall must be more explicit.

I have still another difficulty to place before him for solution. In his article in your June issue, he said that the butterflies referred to were protected when perched, but butterflies are not always perched. My observation of them leads me to believe that they spend the greater part of their brief butterfly existence in fluttering happily from flower to flower in the sunny summer air. When thus engaged, the white under-wing can, of course, be no protection, but rather the reverse, while the brilliant upper-wing must present a very conspicuous object to their enemies the birds, and it is thus, as I have repeatedly seen, that the poor butterfly is caught and killed. How comes it, may I ask Dr. Marshall, that natural selection has provided no protection for the butterflies when most exposed to danger, while supplying it when they are comparatively safe? This is surely very inconsistent and inconsiderate in his friend, and I think requires further elucidation.

Wm. Miller.

Broughty Ferry, 1st August, 1895.

OPTICAL PHENOMENON.

Dear Sir,—I enclose a sketch of the optical phenomenon observed at Juvisy on September 12th, 1894, 5h. 45m., Paris mean time, which may be described as follows:—

The sun was nearly setting, when, all of a sudden, two very narrow lines, like telegraph wires, but *white*, originating from a point of the western horizon *near* the sun, rose in gentle curve towards the east, attaining on the south their maximum height (20°) above the horizon.

The lines were probably parallel, but owing

(apparently) to perspective, their distance, which was over the south some 1° apart, was only half that amount in the vicinity of the sun.

The apparition lasted more than half an hour, having gradually faded away at 6h. 22m.

M. Flammarion, who happened to be present, observed also this remarkable phenomenon.

E. M. Antoniadi.

SATELLITE EVOLUTION.

By Miss A. M. Clerke, *Authoress of "The System of the Stars" and "A Popular History of Astronomy during the Nineteenth Century," &c., &c.*

THE decease of decrepit hypotheses is characteristic of a time of progress, and those dealing with the origin of things are apt to be particularly short-lived. For Nature is, beyond estimation, manifold in its workings. The unravelment of one alone often overtaxes our powers; how much more the simultaneous interaction of many! Thus our knowledge is necessarily made up of partial truths, and partial truths are on occasions indistinguishable from crass falsehoods. Nor is it easy to be wise even after the event. We see that certain things have come to pass, but the "how" evades us. The embodied idea can be apprehended, while the method of its realization remains obscure.

It was with the light-hearted intrepidity commonly associated with imperfect information that Laplace attacked the problem of the growth of the solar system. He was suspiciously successful. In a simple "Note," he described a process adequate to the purpose, not merely in his own judgment, but in that of the whole contemporary learned world. His speculation remained unchallenged for half-a-century. Subversive facts indeed accumulated; yet it was long before they were thought worth the trouble of explaining away. When at last the task was attempted, it was found to be impossible. The French geometrician's neat and complete theory collapsed. That the sun, the planets, and their satellites were somehow derived from a primitive rotating nebula could scarcely indeed be controverted, but the *modus operandi* continued obscure.

One agency of surprising effectiveness, although completely ignored by Laplace, was undoubtedly concerned. In his "Naturgeschichte" (1755), Kant threw out the idea that the moon's rotation was slowed down into correspondence with its rate of revolution by the

frictional resistance of antique tides raised by the earth in its then viscous mass. And if anything can be confidently asserted regarding cosmical pre-history, it is that this arrow hit the mark. But its flight remained almost unnoticed. More than a century elapsed before tidal friction was invoked as a *deus ex machinâ* for bringing to an orderly issue the difficulties and contradictions of lunar theory. This important step was taken by Delaunay. The outstanding acceleration of the moon detected by Adams might, he asserted, prove to be wholly fictitious—the result of a change in our standard of time. Indeed, it seemed obvious that, as the moon had yielded up great part of her axial movement to the earth-raised tides of the past, so the earth must, century by century, undergo a similar retardation through the action of the moon-raised tides of the present. If so, our great world-clock is slowly losing—so slowly that the day lengthens in a thousand centuries by no more than a single second. This simple postulate, however, carries with it a crowd of intricate consequences, inclining the balance alternately this way and that, and rendering it doubtful what the resultant effect of its adoption would be. Moreover, it has ceased to be either available or necessary. Prof. Newcomb has shown that the excess of lunar orbital acceleration, beyond what is demonstrably due to the diminishing eccentricity of the earth's orbit, is so small that it may, for the present, be left to take care of itself; while M. Tisserand concludes the earth's axial retardation to be of insensible amount. Were it the fact that the big pendulum serving to measure our time-intervals was swinging, so to speak, in an imperfect vacuum, the consequences should be universally apparent in the progressive shortening of every celestial cycle, and in the occurrence, in advance of its proper moment, of every celestial phenomenon. M. Tisserand has taken as a test the series of observed transits of Mercury, and he finds no hurry in their succession. Indeed, it is highly probable that the alteration in this respect, which unquestionably took place during some remote age, was in the main completed before the beginning of geological time. Now, to all intents and purposes, the earth "paces even," whirling with soft persistency on its tilted axis.

In the course of these discussions, tidal friction had definitively established its claim to be reckoned with as an evolutionary power of the first order, but as a power acting mainly during the infancy of systems; solid bodies being almost exempt from its influence. Prof. Darwin's treatment of the subject in 1879-81 was a memorable contribution to what may be called genetic astronomy. By strict mathematical reasoning, he traced in the gradually altered relations of the earth and moon, not only the direct effects of tidal friction in checking rotative velocity, but its indirect or reactive effects in producing change of configuration. It appears at first sight far from an "easy thing to understand," that tides raised by one body upon another were the means of pushing them gradually further apart; but the mechanical principle involved is really a very simple one. By the clue of Prof. Darwin's able analysis, the moon was traced back, during the lapse of a hundred millions of years, more or less, to a position close to the earth's surface. An immense tidal wave, produced by its differential attraction, was then kept by the earth's swift spinning somewhat ahead of the satellite, which it accordingly pulled forward in a constantly widening orbit, while serving as a drag upon its primary's axial movement. The rotational momentum, in fact, taken from the earth was (with some loss through the dissipation of heat) added to the orbital momentum of the moon. And the process is nominally still going on, although modern tides are insignificant compared with those of bygone ages.

This research, fortified by a later publication from the same source, left no rational doubt that the birth of the moon was by the protozoan method of "fission"; so that the most authentic conclusion yet reached as to the origin of a heavenly body is in direct contradiction with the plausible surmise of Laplace. Dr. See, of Chicago, has still more recently exhibited a large class of binary stars as manifest products of disruption, of which the subsequent mutual relations have been dominated by tidal friction. This mode of influence acted by comparison feebly (as he infers) in the solar system, owing to the overwhelming superiority of the sun over the planets. They can never have raised any tides worth mentioning upon his surface, and must hence have originated not very far from their present places. But the sun raised tides upon them which did not fail to reduce their primitive rates of rotation. In the case of Mercury, the minimum was probably long ago attained; the grinding-down power has done its utmost by establishing a coincidence between the times of rotation and revolution.

Tidal friction is most effective upon approximately equal masses, and it is because the earth and moon make the nearest approach to a binary combination found within the solar domain, that it has been more strongly exerted upon them than upon any other known subordinate system. Relatively to its primary, the moon is by far the largest satellite of our acquaintance. True, the terrestrial mass is eighty-two times greater; but the disparity between Jupiter and his third (and most considerable) moon is of eleven thousand to one, and four thousand six hundred Titans would be needed to make up Saturn. Particular inquiries into the tidal influences affecting systems so unequally composed thus seemed hardly worth the pains they must have cost. Mr. James Nolan, of Victoria,* however, who has devoted long and not unprofitable attention to this abstruse subject, now alleges arguments to prove that the moulding and modifying, by tidal reactions, of Jovian and Saturnian systemic arrangements, is still quite sensibly progressing. Jupiter's first satellite, for instance, retreats according to his calculation, two hundred and twenty-one times more rapidly from his centre than the moon does, in these modern times, from that of the earth. Its withdrawal is not indeed measured on a linear scale, but by the proportionate increment of momentum supplied by it. As Mr. Nolan explains, "the relative effect of tidal friction on a satellite is inversely as the sixth power of the distance multiplied by the square root of the distance." Obviously somewhat complex relations are in question, and Mr. Nolan determinedly refrains, in developing them, from sullying his pages with a single algebraic symbol. He has succeeded better than could have been expected, since, with close attention, it is possible to keep abreast of his demonstrations. But the effort to do so might perhaps have affected Laplace himself with a megrim; and one can fancy how he would have abandoned it, and with his grave "*Posons*," etc., proceeded to set on foot his familiar analytical apparatus, putting into his formulæ what he chose, and getting out of them what he wanted. It should be added that Mr. Nolan, a competent mathematician, seeks in following the arduous way of elementary exposition, not his own, but the convenience of his readers.

From the evidence furnished by tidal researches alone, Mr. Nolan concludes the systems of the major planets to be in a backward stage of development. As regards move-

* "Satellite Evolution." Melbourne, Sydney, etc., 1895 (George Robertson & Co.).

XUM

PHOTOGRAPHS OF ELLIPTICAL AND SPIRAL NEBULÆ.

By ISAAC ROBERTS, D.Sc., F.R.S.

MESSIER 74 PISCIUM.

HERSCHEL I. 84 COMÆ.

MESSIER 65 LEONIS.

MESSIER 66 LEONIS.

Direct Photo Engraving Co., 9, Barnsbury Park, N.

ment, at any rate, they are still plastic. Their ultimate configurations belong to the future. Even Jupiter's tiny "fifth satellite" is forging its way outward under compulsion of the perennial ripple due to its differential attraction on the huge globe it circuits; although at so tardy a rate, that our author inclines to connect its interior position with its small mass. The feebleness of its tide-raising power obliged it to remain behind its companions, and indirectly occasioned the notable eccentricity of its orbit by subjecting it at close quarters to Jovian tidal friction. There is no sign of its being more juvenile than the Galilean quartet.

The recession of a satellite from its primary implies, as has been said, a transference of momentum. It implies also, as a condition precedent to its occurrence, a period of rotation for the primary shorter than the period of revolution of the satellite. Should this relation be inverted, the direction of the transference of momentum will also be inverted. The attendant body will move along gradually narrowing spires; while, under the inverted influence of a *lagging* tide-wave, the rotation of the dominant body will be correspondingly accelerated. A destructive collision must be the normal result. The inner satellite of Mars is indeed thus circumstanced, yet may continue to subsist during incalculable ages. But, in the first place, it is of negligeable mass; the height of the tidal wave raised by it under the most favourable circumstances should be measured by millimètres. In the second, Mars is probably in no state to yield a sensible tide, even under a far greater stress than Phobos is capable of producing.

We can now easily see that the history of satellites must, in general, be a blank beyond that "critical" past epoch when they revolved synchronously with their primaries' rotation. For, if they fell behind by a hair's breadth, their doom was sealed; they were eventually swallowed up. Of these abortive satellites, Phobos alone, owing to his puny stature, escaped destruction.

The circumstances under which that critical epoch occurred give the only available clue to the modes of satellite-production. The comparatively large size of our moon, and the great power of the friction-brake applied by it to terrestrial rotation, are convincing proofs that the antique earth spun vastly quicker than the modern earth—its speed being such that the moon, when it swung round at the same rate, must have travelled in an orbit scarcely more than eight thousand miles across. Hence the inference that the pair of globes flew asunder when nearly of their actual density.

But their case is exceptional. Jupiter and Saturn can have surrendered but little of their rotational momentum through tidal friction, although that little constituted a considerable addition to the orbital momentum of their comparatively insignificant satellites. Hence none of those satellites can, even at the very beginning of their separate existence, have approached within less than sixty to eighty thousand miles of the actual planetary surfaces. Their origin thus remains cloudy. Mr. Nolan is persuaded that they sprang from primeval formations on the model of Saturn's rings. Yet it appears gratuitous to postulate the former existence of sets of appendages no traces of which have survived. Uranus and Neptune especially, since they have evidently made less progress in development than Saturn, would surely have kept, if they ever possessed such formations. Nature rejects our ideas of uniformity. Creative power has many resources, and the lesson of variety is enforced by the contrast between the biographies of the moon and her compeers. The moon is unique in the solar system—unique in her origin, unique (not improbably) in her solitary condition. The two peculiarities are certainly not unconnected.

PHOTOGRAPHS OF ELLIPTICAL AND SPIRAL NEBULÆ.

By ISAAC ROBERTS, D.Sc., F.R.S.

SPIRAL NEBULA M. 74 PISCIUM.

R.A. 1h. 31m. 19s., Decl. North 15° 16′.

Scale, 1 millimètre to 12 seconds of arc.

THE photograph was taken with the 20-inch reflector on December 9th, 1893, between sidereal time 1h. 7m. and 5h. 24m., with an exposure of the plate during three hours and forty minutes.

REFERENCES.

N. G. C. No. 628, G. C. No. 372, h 142.

Sir J. Herschel (*G. C.* 372, p. 52) states, as the result of eleven observations, that it is a globular cluster, faint, very large, round, pretty suddenly much brighter in the middle, partially resolved.

Lord Rosse (*Phil. Trans.* 1861, p. 711) designates it as a spiral nebula with the centre formed of stars, and several stars visible through the nebula. A marginal sketch is given which shows the spiral form, and in the *Observations of Nebulæ and Clusters of Stars*, p. 21, another marginal sketch is given which shows a nucleus and five stars involved in the spirals.

The photograph shows the nebula to be a very perfect spiral with a central, nebulous, stellar nucleus and a 15th magnitude star close to it on the south side. The convolutions of the spiral are studded with many stars and star-like condensations, and on the *north preceding* side there is a partial inversion of one of the convolutions which is suggestive of some irregular disturbing cause having interfered with the regular formation of a part of that convolution.

ELLIPTICAL NEBULA H. I. 84 COMÆ BERENICIS.

R.A. 12h. 45m. 33s., Decl. North 26° 3′.

Scale, 1 millimètre to 12 seconds of arc.

The photograph was taken with the 20-inch reflector on May 7th, 1894, between sidereal time 12h. 31m. and 14h. 1m., with an exposure of the plate during ninety minutes.

REFERENCES.

N. G. C. No. 4725, G. C. No. 3249, h 1451.

Sir J. Herschel (*G. C.* 3249) describes the nebula as very bright, very large, extended, very gradually then very suddenly very much brighter in the middle, with an extremely bright nucleus.

Lord Rosse (*Obs. of Neb. and Cl. of Stars*, p. 121) records six observations of the nebula made between 1850 and 1867, and describes it as another spiral with two arms and some stars in the *following* arm; very large and very bright. The centre itself is like an elongated nebula with a nucleus, and enveloped in an irregular ring or rings of nebulous light. He gives a rough marginal sketch of it.

The photograph shows the nebula to be a symmetrical ellipse, and not a spiral, with the major axis in *north following* to *south preceding* direction, and the nucleus to be a nebulous star of about the 12th magnitude. Both the star and the nebulosity surrounding it have well-defined margins, the nebulosity having a ring-like boundary. Surrounding the nucleus, at a great distance, is a well-defined ring, but deformed on the *north following* side, and in the ring are involved several star-like condensations of nebulosity. Outside this ring is another faint ring, symmetrical with it, and also discontinuous, like the first, on the *north following* side; and there is in it some evidence of the existence of another very faint ring outside this. In the divisions between the rings are

five well-defined stars of 15th to 16th magnitude, that may or not be physically connected with the nebula.

ELLIPTICAL NEBULA M. 65 LEONIS.

R. A. 11h. 13m. 42s., Decl. North 13° 38′.

Scale, 1 millimètre to 12 seconds of arc.

The photograph was taken with the 20-inch reflector on February 28th, 1894, between sidereal time 8h. 19m. and 12h. 2m., with an exposure of the plate during three hours and forty minutes.

REFERENCES.

N. G. C. No. 3623, G. C. No. 2373, h 854.

Sir J. Herschel (*G. C.* 2373) describes the nebula as bright, very large, much extended in the direction 165°±, gradually brighter in the middle, with a bright nucleus; eight observations were made. In the *Phil. Trans.* for 1833, Pl. XIV., Fig. 53, he gives a drawing, but it does not compare well with the photograph.

Lord Rosse (*Phil. Trans.* 1850, Pl. XXXVII., Fig. 7) gives a drawing of the nebula, and on p. 512 states that it is resolvable, a spiral or an annular arrangement about it, no other portion of the nebula resolved; and in the *Obs. of Neb. and Cl. of Stars*, p. 95, he gives the results of eight observations made between the years 1849 and 1861, and states that he suspected seeing at times dark spaces on either side of the nucleus, and some mottling and stars sparkling in it. He also saw a star close *following* the nucleus, but did not see the curious ring which he says Sir J. Herschel saw.

Lassell (*Mem. R. A. S.*, Vol. XXXV., p. 43, and Pl. III., Fig. 15) describes the nebula as faint, irregular, formless, and suspected that he saw some stars in it. The drawing does not resemble the photograph.

The photograph shows the nebula to be a symmetrical ellipse with a well-defined stellar nucleus surrounded by dense nebulosity, in the midst of which is a spiral ring filled with nebulosity; and this, together with the nuclear condensations, is surrounded by two elliptical rings of nebulosity, separated by a dark space. Five star-like condensations of nebulosity are involved in the rings, and one bright star is in the dark space between them, on the *south following* side of the nucleus. The nebula as a whole is more perfectly symmetrical than the Great Nebula in *Andromeda*, of which class it is clearly a type; but I have not before seen on any of my photographs a spiral with a stellar nucleus, involved in the dense central nebulosity.

SPIRAL NEBULA M. 66 LEONIS.

R.A. 11h. 15m. 1s., Decl. North 13° 32′.

Scale, 1 millimètre to 12 seconds of arc.

The photograph was taken with the 20-inch reflector on February 28th, 1894, between sidereal time 8h. 19m. and 12h. 2m., with an exposure of the plate during three hours and forty minutes.

REFERENCES.

N. G. C. No. 3627, G. C. No. 2377, h 857=875.

Sir J. Herschel (*G.C.* 2377) describes the nebula as bright, very large, much extended in the direction 150°, much brighter in the middle, two stars *n. p.*; nine observations made. In the *Phil. Trans.* 1833, Pl. XIV. Fig. 54, a drawing of it is given which, in outline, resembles the photograph, but the extension is in the direction of about 180°.

Lord Rosse (*Obs. of Neb. and Cl. of Stars*, p. 95) describes it as a spiral, well resolved about the nucleus, but in no other part, two stars involved in it, with others and knots of nebulosity suspected; could not resolve the nucleus. A marginal sketch is given and a drawing in the *Phil. Trans.* 1861, Pl. XXVII., Fig. 16, where some spirals are shown, but the resemblance to the photograph is not evident. Eleven observations were made between the years 1848 and 1857.

The photograph shows the nebula to be an imperfect spiral with a well-defined stellar nucleus which forms the pole of the convolutions, involved in which I counted fourteen nebulous star-like condensations. We see in this nebula much that is suggestive of a transition state into the more perfect form of spiral.

It should be understood that my remarks concerning the four nebulæ which have been referred to are based upon the examination of the original photo-negatives, and that many faint details are visible upon them which cannot be fully reproduced upon the paper prints.

NOTE.—Referring to the area of the sky represented by the photograph containing the Cluster and Nebula in *Argûs*, in the last number of KNOWLEDGE, it should be between R.A. 7h. 34m. 40s. and R.A. 7h. 39m. 40s.; Decl., between 13° 46′ and 15° 21′ South, instead of the co-ordinates given in the letterpress.

BLIND CAVE-ANIMALS.

By R. LYDEKKER, B.A.Cantab., F.R.S.

I READ the other day, in an American scientific journal, how that a labourer, while digging a well in Orange County, at a depth of about thirty feet below the surface, struck a subterranean rivulet, and that with the water from the same were brought up to the daylight several blind and colourless crayfish, which proved to belong to an unknown type. This led me to think that the readers of KNOWLEDGE might be interested to learn something regarding the large assemblage of blind animals of various kinds which inhabit caves and subterranean waters in different parts of the world.

True cave-animals, that is, those which are blind and more or less completely colourless, and spend their whole time in utter darkness, must be sharply distinguished from creatures like bats and owls, which take advantage of such situations as a temporary shelter, from which they issue forth at night to the outer world. And as most of these are more or less closely allied to animals which enjoy the full light of day, one of the first things that strikes one is why they have given up the joys of an ordinary existence, to pass, what appears to us to be, a miserable life in total darkness. Whatever be the true explanation of this, it is of course easy to understand why they should have lost their eyes, and also the coloration characteristic of their outer-world relatives.

A curious parallel exists between the inhabitants of caves and those creatures dwelling in the dark abysses of the ocean depths; both living in situations entirely cut off from the smallest trace of daylight, and both being descended from animals living either in air or water under the ordinary conditions. In one point, however, a remarkable difference exists between the two. Cave-animals, as already said, are content to crawl or swim in Cimmerian darkness, whereas the finny and other denizens of the depths of the ocean possess organs giving forth a brilliant phosphorescent light, and likewise other organs by which they can perceive such light, and are thus able to see and capture their prey with ease. In the absence of such artificial light and special modes of vision, cave-animals are of course compelled to rely solely on their organs of touch, hearing, and perhaps of smell; and, to our thinking at least, their life must be far more dreary and devoid of

pleasure than is that of the inhabitants of the deep sea. Possibly, however, there may be other compensating advantages unknown to us; and, in any case, they lead a life of peace unmolested by the various carnivorous tyrants of the outer world. It is, however, very noteworthy that there is one blind fish inhabiting the ocean at great depths, and that a member of the same family is also found in the caves of Cuba; and this instance seems to indicate that certain families of fishes are better suited than others for taking to a subterranean existence.

Caves or subterranean channels containing the typical blind fauna are met with in many parts, apparently invariably in limestone rocks, and mostly in those belonging to the Carboniferous epoch; the latter, from their massiveness, being especially adapted for the formation of such chambers by the action of water. Needless to say, the formation of a cavern of any size in solid limestone rock is a process involving an enormous length of time for its accomplishment, and it is therefore essential that the rock should be of very considerable geological age. Indeed, it is believed that the formation of the celebrated Mammoth cave was commenced at a comparatively early date in the Secondary era, although it was not completed till the Pleistocene. The reader must not, however, be led to suppose that cave-animals belong to an older epoch than those of the outside world, as it is probable that many of them have not taken to their present mode of existence since the later Pliocene or early Pleistocene period.

Caves of sufficient dimensions to have developed a special fauna of their own are met with in so many parts of the world, that it would be tedious to give a list even of those which are most generally known. Among those that have attained the widest degree of celebrity is the Mammoth cave, situated in a hill of limestone in Edmonston County, a little to the south-west of the centre of Kentucky. This enormous cave is adorned with the most beautiful stalactitic and other deposits, which, when lit by the magnesium or the electric light, form an enchanting sight.

Another well-known American example is the Wyandotte cave, traversing the Carboniferous limestone of Crawford County, in south-western Indiana. Of this cave, Prof. Cope wrote in 1872 that he was not aware whether its length had ever been accurately determined, "but the proprietors say that they have explored its galleries for twenty-two miles, and it is probable that its extent is equal to that of the Mammoth cave. Numerous galleries which diverge from its known courses in all directions have been left unexplored." The fact that the blind cave-fish appears to occur in all the subterranean waters flowing through the great Carboniferous limestone region of the central districts of the United States, suggests that the Mammoth and the Wyandotte caves are in communication. Almost equally celebrated are certain caves in the island of Cuba, which are also traversed by subterranean streams. In Europe, perhaps the most interesting cave is that of Adelsberg in Carniola, as being, together with certain other caves in Carinthia and Dalmatia, the sole habitat of that strange creature, the olm or proteus, so graphically described many years ago by Sir Humphry Davy. Although the Carinthian and Dalmatian forms of this creature differ slightly from the Carniolan type, there can be little doubt that the subterranean waters of all the three countries are, or were at a comparatively recent date, in free communication. Several caves with the blind fauna are met with in Western Europe, some of the most notable being those in various parts of the south of France; but the only one in the British Islands is Mitchelstown cave, near Fermoy, in Ireland, which is excavated in the Carboniferous limestone.

The animal of the highest zoological position occurring among the true cave-fauna is the aforesaid olm, which is the sole representative of the genus *Proteus*, and is allied to the ordinary salamanders and newts. The olm is a somewhat eel-like creature, measuring about eleven inches in length, and with a uniformly flesh-coloured skin, save that the branching external gills are brilliant scarlet. The limbs are very short and weak, the front pair being provided with three and the hinder with two toes, and the eyes are completely hidden. Now it is a most remarkable fact that the only other salamander referred to the same family (*Proteidæ*) as the olm is a single North American species with well-developed eyes, four toes to each foot and a dark brown skin, which constitutes the genus *Necturus*; and from this it may be inferred that the ancestral type of the two genera formerly inhabited the northern hemisphere, and that while its transatlantic descendant has preserved the primitive number of toes and adhered to an ordinary mode of life, the European species has become more specialized in regard to its limbs, and has taken to a completely subterranean existence. According to Sir Humphry Davy, the olm only makes its appearance in the Adelsberg grotto when the waters rise to an unusual height, remaining at other periods in the streams flowing beneath its floor.

The only other vertebrate animals belonging to the true cave-fauna are fish of several species. By far the most celebrated among these is the well-known blind-fish

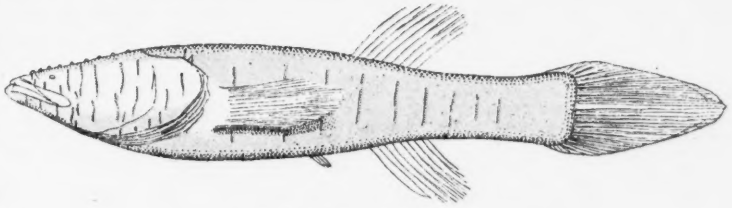


FIG. 1.—The Blind-Fish.

(*Amblyopsis spelæa*), which has been taken in both the Mammoth and the Wyandotte caves, as well as in the intervening subterranean waters. This fish is the typical representative of a small family allied to the cyprinodonts, which are themselves relatives of the carps. It is quite destitute of external eyes, and its body is completely colourless; but its sense of hearing is extraordinarily developed. In the typical form this fish has a small pair of pelvic fins, but in some examples (which have been referred to a distinct genus under the name of *Typhlichthys*) these are wanting. The maximum length is five inches. Prof. Cope writes that if these fish "be not alarmed, they come to the surface to feed, and swim in full sight like white aquatic ghosts. They are then easily taken by the hand or net, if perfect silence is observed, for they are unconscious of the presence of an enemy except through the medium of hearing. This sense is, however, evidently very acute, for at any noise they turn suddenly downward, and hide beneath stones, etc., at the bottom. They must take much of their food near the surface, as the life of the depths is apparently very sparse."

The only other genus in the family is known as *Chologaster*, differing from the last in the retention of small external eyes, and likewise in the skin being coloured. Pelvic fins are absent, and the front of the head is provided with two horn-like appendages. These small fish were first known from three examples taken in

the ditches of the South Carolina rice-fields; but another specimen was caught in a well in Lebanon County, Tennessee, in the year 1854. They appear to have taken to a partially subterranean life comparatively recently, and therefore retain their eyes and dark coloration.

Although these cave-fish are clearly allies to the cyprinodonts, there is no evidence to show that they are directly descended from any member of that family. Such a descent is, however, indicated by a very remarkable family of fishes known as the *Ophidiidæ*, which are near relatives of the cod tribe. With the single exception of the cave-fish of the caves of Cuba (*Lucifuga dentata*),

FIG. 2.—Cuban Cave-Fish.

all the members of the family are marine forms, some inhabiting shallow water, while others are found only at great depths. Now the Cuban blind fish, in which the eyes are either totally wanting or rudimentary, is a very close ally of a marine form named *Brotula*, in which the eyes are fully developed, and has evidently been specially modified from the former for a subterranean existence. The barbels, which are present in the marine fish, are replaced in the cave form by minute tubercles. This, however, is not the only point connected with this curious family, as there are two species, belonging to as many genera (*Typhlonus* and *Aphyonus*), found at great depths in the southern oceans, which are also completely blind, and apparently have no phosphorescent organs. And it would appear from these examples that the fish of this family have some special disposition towards a life of darkness.

The only other fish that can be said to belong to the cave-fauna is a member of the great freshwater family of cat-fishes (*Siluridæ*), and has been named by Prof. Cope *Gronias nigrilabris*. This fish, which attains a length of about ten inches, is closely allied to an ordinary freshwater American form, and occurs in the Conestoga river in Lancaster County, Pennsylvania, where it is stated to be occasionally taken by the fishermen, and is believed to issue from a subterranean stream said to traverse the limestone of that district, and to discharge into the Conestoga river. Although blind, this fish has a rudimental eye, and is therefore in process of modification for a completely subterranean life.

To refer in detail to the invertebrate inhabitants of caves would far exceed our allotted limits, and only a few words can be said on this part of the subject. Among the most interesting are the blind cray-fish, in the ordinary form of which (*Cambarus*) the eyes are rudimental in the adult, but larger in the young, thus affording conclusive evidence of their descent from forms fully endowed with vision. Prof. Cope has, however, described one cray-fish from the Wyandotte cave in which the eyes are completely wanting. Among the insects, there is a totally blind beetle (*Anophthalmus*) belonging to the family of *Carabidæ*, or tiger-beetles, from the American caves; while those of France and Ireland have yielded a blind and colourless spring-tail (*Lipura*). Wingless grasshoppers are abundant, but these, at least generally, can see. Centipedes and spiders are also common, one of the former from the Mammoth cave being totally blind, while others retain their eyes. In the European species of cave-spiders (*Parrhoma*) the eyes are excessively minute, and tend to become obsolete; but it is noteworthy that these creatures belong to a genus in which the eyes are small even in the open-air kinds.

It is thus apparent that all cave-animals are descended from allied forms living in the outer world, and that in many cases they belong to families which appear specially adapted for modification to a subterranean existence.

One of the most interesting discoveries is the close alliance between creatures inhabiting caves widely remote from one another. Writing of the animals of the Mitchelstown cave, Mr. G. H. Carpenter observes that the springtail "is hardly to be separated from a species found in the caves of Carniola, and the *Sinella* (another blind and bleached insect) is almost identical with one inhabiting the caves of North America; while the spider is apparently the same as a cave-dweller from the Mediterranean district of Southern France, which probably occurs in the North American caverns also. . . . Any possible geographical connection which would permit the migration of subterranean animals between Southern Europe or Ireland, or between Ireland and North America, seems altogether out of the question within any period during which the fauna can have been specifically identical with that of the present day. The only conclusion is that from ancestors, presumably of the same genus, which took to an underground life in such widely-separated localities, the similar conditions of the caves have evolved descendants so similar that when compared they cannot, or can hardly be specifically distinguished from each other."

Should these identifications be confirmed, it will be evident that the same, or closely allied species, have originated independently in different caves, and although the author cited is of opinion that this phenomenon may only hold good with regard to cave-animals, we are inclined to think that it may be found also to exist in the outer world, since it has been suggested that the horses (*Equi*) have originated independently in the Old and New Worlds from different ancestral stocks.

HELIUM, TOGETHER WITH A FEW NOTES ON ARGON.

By GEORGE MCGOWAN, PH.D.

ALTHOUGH only five months have elapsed since Prof. Ramsay announced his discovery of terrestrial helium to the Chemical Society at the anniversary meeting of the latter on March 27th, the large number of letters and papers—speculative and otherwise—which have since been contributed to scientific journals and magazines, either upon helium alone, or upon helium and argon together, shows what widespread interest it has awakened. The July number of the *Journal of the Chemical Society* contains a further paper upon "Helium, a constituent of certain Minerals," by Prof. Ramsay, Dr. Collie, and Mr. Travers, which gives the results of their work upon the new gas up to date; it seems, therefore, a fitting opportunity to present a short sketch of the subject to the readers of KNOWLEDGE.

Nearly thirty years have passed since the spectrum of the solar chromosphere and prominences was discovered to consist of the lines of hydrogen, and of a bright line in the yellow, since known as D_3. But, until the other day,

the line had never been detected in the spectrum of any constituent of our planet, and on this account the name *helium* was given to the element producing it, as being entirely a solar element, although, as now appears, it is pretty widely distributed in small quantities in certain classes of rare minerals. This is the first instance on record of an element known to exist in the sun being subsequently discovered on the earth, though it will probably not be the last, for there are lines in the solar spectrum which we are unable to reproduce from any known terrestrial element. One of these hypothetical elements, giving a line in the green portion of the spectrum, forms a large part of the sun's corona, and is believed to be a gas even lighter than hydrogen. In a short note upon helium, communicated to the Royal Society last May, Mr. Lockyer says* :—"We appear to be in presence of the *vera causa*, not of two or three, but of many of the lines which, so far, have been classed as 'unknown' by students both of solar and stellar chemistry; and if this be confirmed, we are evidently in the presence of a new order of gases of the highest importance to celestial chemistry, though perhaps they may be of small practical value to chemists, because their compounds and associated elements are for the most part hidden deep in the earth's interior."

The way in which the discovery of terrestrial helium came about is interesting, and it may be recapitulated shortly here. Argon, as everyone now knows, is an extremely inert substance, and as a matter of fact there are only two instances as yet of chemical combination on its part, M. Berthelot having recently succeeded in forming a hydrocarbon compound of argon by subjecting a mixture of the latter with the vapour of benzene to the influence of the silent electric discharge, and also in inducing the gas to combine with carbon disulphide and mercury under similar conditions. M. Berthelot's experiments were of necessity made with very small quantities of pure argon—much too small to allow of anything more than a qualitative observation; they have, however, established the important facts that argon can be made to enter into chemical combination with other elements, and can be regenerated from the compounds formed with its initial properties intact.† In continuance of the search after possible compounds of argon last spring, Prof. Ramsay's attention was called by Mr. Miers, of the British Museum, to the rare Norwegian mineral clèveite, which consists mainly of uranate of lead associated with rare earths, and which was said to give off two per cent. of nitrogen when warmed with dilute sulphuric acid. Thinking that this supposed nitrogen might very likely be argon, he obtained some of the mineral and liberated the gas from it. The spectroscopic examination of the latter showed an extremely brilliant yellow line close to, but not coincident with, the two yellow sodium lines D_1 and D_2. Not having at the time a spectroscope with which accurate measurements could be made, Prof. Ramsay sent a Plücker's tube of the gas to Mr. Crookes, who found the wave-length of this new yellow line (D_3) to be 587·45, the wave-lengths of the sodium lines being D_1=589·51, and D_2=588·91. The spectrum of the gas was, therefore, that of the solar element helium. Profs. Runge and Paschen, of Hanover, have since shown‡ that the yellow helium line is itself a double one, its less refrangible component being much the weaker of the two, while the stronger one is brilliant. They give the following wave-lengths for these :—

Strong component = 5875·883
Weak ,, = 5876·206,

Rowland's determination of D_3§ being 5875·982. Lastly, a week or two ago Dr. Huggins¶ observed the double line in the solar spectrum, stating at the same time that he understood it had been already observed in the United States by Prof. Hale. This would appear to make it absolutely certain that solar and terrestrial helium are identical.

A large number of rare minerals have been examined by Prof. Ramsay and his colleagues for helium, these being described in detail in the memoir already referred to at the beginning of this paper. The conclusion at which they arrive is that helium is retained by minerals consisting of salts of uranium, yttrium and thorium, but whether its presence is conditioned by the uranium, the yttrium, or the thorium has not yet been established. None of the oxides of uranium, when heated in an atmosphere of helium and allowed to cool, retain the gas; but similar experiments have not yet been made with oxides of thorium and yttrium, or with a mixture of these with uranium oxide. The minerals which gave much the best yield, and which, indeed, up to the present have been the only available sources of helium, are clèveite, bröggerite, and the uraninite investigated by Hillebrand. Monazite, which also gives a good yield of helium, is a phosphate of cerium, lanthanum and thorium, uranium being absent. Being comparatively cheap, it would form a more economical source of helium than either clèveite or bröggerite.

On account of their rarity and cost, only small quantities of the above-mentioned minerals could be used. To extract the helium, from two to five grammes of the coarsely powdered substance were heated in a small bulb of combustion tubing, previously exhausted by a Töppler's pump. As water vapour and carbon dioxide were often evolved at the same time, a soda-lime tube and a tube filled with phosphoric anhydride were frequently interposed between the bulb and the pump. After most of the gas had been given off, the temperature was raised until the glass bulb showed signs of collapsing. A further quantity of gas was obtained by mixing the residue from the heated bröggerite or other mineral with hydrogen-potassium sulphate, and re-heating. To get rid of the free hydrogen evolved in most cases along with the helium (there was no chemically combined hydrogen, *i.e.*, no hydride of helium), the gas was sparked with oxygen, no alkali being present. The excess of oxygen was then absorbed by alkaline pyrogallate, and the gas transferred to a vacuum tube for spectroscopic examination. This process of transference has proved very convenient, and has prevented any waste whatever of the gas.

The apparatus "consists of a tube provided with a perfectly fitting stopcock; this tube is connected with a Töppler's pump. The vacuum tube or tubes to be fitted are sealed to a lateral branch above the stopcock. The lower part is bent into a sharp U, and the end drawn out to a point and sealed. The stopcock is then turned full on, and the whole tube is completely exhausted, until the vacuum tube shows brilliant phosphorescence, or, indeed, as often happens, ceases to conduct the discharge; the stopcock is then closed. A mercury trough is placed below the bend of the tube, and the latter is sunk until the closed end disappears below the mercury. A small tube, which need not contain more than 1 c.c. of the gas to be introduced into the vacuum tube, is

* *Nature* of May 16th, 895.

† Prof. Ramsay also appears to have succeeded quite lately in inducing argon to combine chemically, by making an arc with two thin carbon rods in the gas (see *Chemical News* of August 2nd, 1895).

‡ *Nature* of June 6th, 1895.

§ *Philosophical Magazine*, July, 1893.

¶ *Chemical News* of July 19th, 1895.

then placed over the closed end of the bent tube, and the mercury trough is lowered. The sealed end is then broken by pressing it against the interior of the gas tube, when gas enters up to the stopcock. On carefully opening the stopcock a trace of gas is passed into the vacuum tube; this gas is then pumped out and collected below the delivery tube of the Töppler's pump. One such washing with gas is usually sufficient. The stopcock is again opened, and a sufficient amount of gas introduced into the vacuum tube to show the spectrum. The vacuum tube is then removed by sealing, and the gas still remaining in the bent tube may be transferred to the pump and collected. It is seen that this method permits of the filling of a vacuum tube absolutely without loss, and—it may be added—with great expedition."

It is further interesting to notice at this point that the discoverer has also found small quantities of argon and helium in the gas obtained by heating *in vacuo* a piece of a meteorite found in Virginia, the argon being present in relatively much larger amount than the helium. This is the first time that argon has been found in any extra-terrestrial substance; it has not yet been recognized in the sun. This particular investigation showed very clearly how little reliance is to be placed on the evidence of the spectroscope as to the presence of any one gas in a mixture where other gases predominate. Thus, the characteristic spectrum of argon is almost completely masked by the presence of a few parts per cent. of nitrogen or of hydrogen, and that of helium is similarly affected, although to a less degree. The author suggests that in future much attention should be paid here to the relative conductivities of gases.

The spectrum of helium is characterized by five very brilliant lines, which occur in the red, the yellow, the blue-green, the blue, and the violet. The double yellow line, D_3, which is the most characteristic, has been already referred to in detail. No one who has seen this spectrum is ever likely to forget its extraordinary brilliancy. An exhaustive study of it is being made by Mr. Crookes. With regard to the spectrum, Prof. Ramsay and his coadjutors point out "that at least two of the lines in the spectrum of helium, seen with a wide dispersion prism, are coincident with two of the argon lines. These occur in the red, and comprise one of each of the two pairs of characteristic argon lines. . . . We may say that if not absolutely identical, the lines are so near that it is not possible with the means at our disposal to recognize any difference in position. But the relative brilliancy is by no means the same. One of the argon lines, rather faint, is coincident with the prominent red of the helium spectrum, and one of the strong red argon lines is coincident with a faint red line in the helium spectrum."

Next to the spectrum, the property of helium which it was of most interest and importance to determine was the density. Unfortunately, most of the minerals employed as a source gave such a minute yield, amounting usually to only a few cubic centimetres, that a determination of density was in their case out of the question. Very careful estimations were, however, made with the gas from clèveite and from bröggerite. Even here the quantity of gas available was but small, the capacity of the bulb used for most of the weighings being only about thirty-three cubic centimetres. But care in manipulation and the use of a very sensitive balance by Oertling made it possible, even under these conditions, to arrive at results nearly approaching to accuracy. The original paper must be consulted for all the precautions taken to purify the helium, whose density was in question, from every trace of hydrogen sulphide, carbon dioxide, sulphur dioxide, hydrogen and nitrogen. Let it suffice to give here the results of three determinations, of which "the mean may be taken as approximately correct to within 0·05":—

	Density.
Gas from bröggerite by heating	2·152
Gas from bröggerite with hydrogen-potassium sulphate	2·187
Gas from clèveite	2·205
Mean ... ... =	2·181

(the density of oxygen being taken as 16). All these three samples were then mixed together, and the whole treated again for the absorption of any traces of hydrogen and nitrogen remaining, after which the density was found to be 2·218, *i.e.*, it remained substantially unaltered. A determination in another sample gave the figure 2·133. Helium is thus, next to hydrogen, the lightest of all known elements.

Again, as in the case of argon, it has been found to be a *monatomic* gas, the ratio of the specific heat at constant volume to that at constant pressure being 1·632 (another determination gave 1·652)—a sufficiently close approximation to the theoretical number 1·66.

Helium is very sparingly soluble in water, 100 volumes of the latter at 18·2° C., *i.e.*, at about the ordinary temperature, dissolving only 0·73 volumes of helium. This is the lowest solubility yet recorded for any gas, and it points to the boiling temperature of liquid helium being very low. Prof. Olszewski, of Cracow, has undertaken to make experiments on the temperature of liquefaction of helium, "and it will be interesting to learn whether its boiling point does not lie below, or at least as low as that of hydrogen. For their molecular weights are not very different, and helium is a monatomic gas, a condition which appears to lower the boiling point."

So far, but few attempts have been made to induce helium to enter into chemical combination with other elements, but those experiments which have been tried have all proved ineffectual. Like argon, it is not attacked by oxygen in presence of caustic soda under the action of the electric discharge, this forming in fact a good method of removing all impurities other than argon. Further, like argon, it is not affected by red-hot magnesium, and it is not oxidized by copper oxide at a red heat. No method has yet been found by which helium and argon can be separated from one another.

Towards the close of their paper, the authors draw some general conclusions, so far as their present knowledge of the subject warrants this. "It cannot be doubted that a close analogy exists between argon and helium. Both resist sparking with oxygen in presence of caustic soda; both are unattacked by red-hot magnesium; and, if we draw the usual inference from the ratio between their specific heats at constant volume and at constant pressure" (the significance of which, however, is by no means universally conceded, not, for instance, by Mendeléeff), "both are monatomic gases. These properties undoubtedly place them in the same chemical class, and differentiate them from all known elements." The properties of helium itself not having yet been sufficiently investigated, the authors proceed to discuss those of argon, with the view of seeing how far these corroborate the deduction that the latter is a monatomic element, and the conclusion at which they arrive is that, while the considerations referred to cannot be accepted as evidence, they are corroborative of the conclusions as to the monatomicity of argon. "If they apply to argon, they apply with equal force to helium; and if they are accepted, it follows that the atomic weight of helium is 4·26," that of argon being 39·8.

With regard to the question, why is not helium, like argon, present in the air? the authors are inclined to

accept Dr. Johnstone Stoney's argument* that the former would, in virtue of its own proper molecular motion, remove itself from our planet, and emigrate to a celestial body possessing sufficient gravitational attraction to hold it fast.

But the supreme point of interest still to be determined with regard to argon and helium is, are they elements or only mixtures of elements? If argon possesses the atomic weight 40, there is no place for it in the periodic system of the elements; and up to now no exception to this arrangement exists, if the doubtful case of tellurium be excluded. There are various arguments both for and against argon and helium being elementary. If what has just been said about their spectra containing certain lines in common turns out, on further investigation, to be justified, then the only conclusion is that the two gases contain some element in common (excluding the extremely improbable hypothesis, of which there is as yet no instance, of two elements giving spectra containing identical lines). The subject presents many serious difficulties, but these will no doubt be satisfactorily overcome in time. If the two discoveries of argon and helium had possessed no intrinsic interest in themselves, they would have been invaluable as being the means of bringing home to many chemists, and to others interested in chemistry, a large number of issues of the first importance in the science.

THE COLDEST INHABITED SPOTS ON EARTH.

By CARL SIEWERS.

ACCORDING to all records which we possess, the coldest inhabited spot on earth is Werchojansk, in Eastern Siberia, under the Polar Circle, where the annual mean temperature is 2·2° F. or thirty-five degrees of frost. During the months of January, February, and March, the thermometer generally remains at 56° below zero, indicating eighty-eight degrees of frost, and on certain particularly cold days the spirit thermometer—mercury thermometers are useless in such cold—falls to 83° below zero, Fahrenheit, or one hundred and fifteen degrees of frost. Spring has a mean temperature of 28·4° or four degrees of frost, and during the "lovely month of May" the temperature remains at zero. During the "hot" months, July, August, and September, the mean temperature at Werchojansk is 42·8°, but in the three following months of the year the mean again declines to 34·6°.

A striking contrast to this terribly cold climate is furnished by that of the little colony, Angmasalik, on the east coast of Greenland, on the opposite side of the globe, and nearly in the same latitude, about 65½°. The climate here is, comparatively speaking, "mild," the annual mean temperature being only 26·6°, or seven degrees of frost. The winter has a mean temperature of 14°, spring a mean temperature of 32°, summer one of 37·4°, and autumn a mean temperature of 24·8°. The changes of temperature here are, however, not nearly so great as at Werchojansk, as the sea, which is in close proximity, acts as a regulator. However, Angmasalik is far from being a pleasant place of residence, as the weather is invariably "raw cold" and stormy, while the shores are generally choked with drift ice as far as the eye can reach. The shores of East Greenland are, as is generally known, almost unapproachable on account of the drift ice.

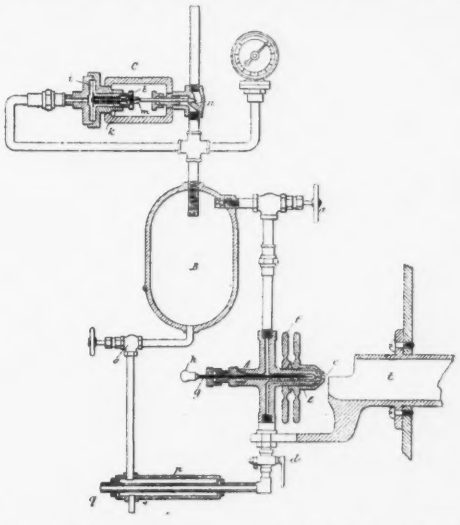
At Angmasalik, whither the Danish Captain Holm penetrated for the first time in 1883, there was a colony of Eskimo, numbering some 400, which had never before come into contact with civilized people. When Lieutenant Kydew reached the colony ten years after, the population had dwindled to 300. There was then established a trading and mission station here, coupled with a meteorological observatory. The Danish Greenland steamer "Hvidbjörnen" (White Bear) is now to call every autumn at this colony; but it may be doubted whether this will be possible on account of the ice. Anyhow, the colony and the steamer are provisioned for several years should the latter be blocked in the Polar pack.

Woman of Angmasalik with Baby.

* *Chemical News*, LXXI., 67 (1895).

Some Recent Patents.

John Lee Osborn, Millbay Engineering Works, Plymouth (a communication from Carl Neuhaus, Vienna). Improvements in apparatus for burning liquid fuel. This invention relates to burning oil for steam boilers and the like. Steam to the atomiser A is taken from the steam chamber and separator B by opening the steam valve *a*,



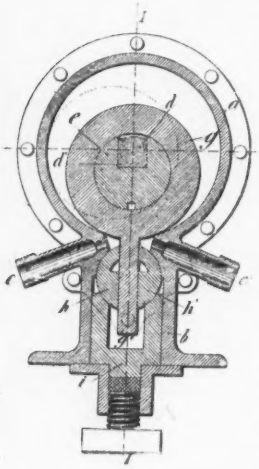
which causes the steam to blow through the fine opening *c* in the atomiser. Oil is admitted by the cock *d*. By unscrewing the cap *e* the oil enters and is atomised by the steam jet, and, after mixing with air, is thrown into the fire tube *f* in the form of spray, which is

ignited by a torch. *f* is a lock-nut to the cap *e*. The needle *g* is used to clear the fine steam channel by pushing it through it by the wooden handle *h*. C is a reducing valve to equalise the pressure of the steam containing a membrane *i* on which steam pressure is counteracted by a spring *k*, regulated by the nut *l*. Condensed water from the chamber B is used to heat the oil, whereby complete combustion is effected, without the necessity of applying a constantly burning torch.

No. 15,773. *Dated* 18*th August*, 1894. *Accepted* 6*th July*, 1895. *One figure.*

Charles Guest, Longsight, Manchester. Improved means of transmitting power by belt gearing. Rotary motion is transmitted from one grooved pulley to another, by means of a flexible tube filled with air, or other vapour, under pressure. For driving cycles an india-rubber tube, of, say, half an inch in diameter, is used, the two ends being joined by dissolved rubber or solution. A small valve is inserted and the tube is partly inflated, or it may be filled with chalk-dust or other powder, which is afterwards removed through the valve. The tube is then wrapped round with canvas or other fabric, the whole being bound together with glue or solution, in such a manner that the air pumped into the tube will be held under pressure.

No. 17,685. *Dated* 17*th September*, 1894. *Accepted* 20*th July*, 1895.



Geraud Marty, Puymirol, Département de Lot-et-Garonne, France. Improvements in rotary pumps. *a* is a cylindrical casing formed at its lower end with a foot *b*, capable of being fixed to a frame. *c* and *c'* are inlet and outlet passages. *e* is a cylinder eccentrically attached to the square end of a driving shaft *d*. *g* is a ring or piston which moves in contact with the interior of the casing *a*, and having a leg *g'* sliding between two segments *h h'*. The action of the pump will be readily understood from the drawing. A double acting pump, with two cylinders, is also described and illustrated.

No. 18,376. *Dated* 28*th September*, 1894. *Accepted* 20*th July*, 1895. *Four figures.*

THE FACE OF THE SKY FOR SEPTEMBER.

By Herbert Sadler, F.R.A.S.

SUNPOTS and faculæ, though decreasing in number and magnitude, are still tolerably abundant on the solar surface. There will be a partial eclipse of the Sun on September 18th, but it will only be visible in East Australia and New Zealand. Conveniently observable minima of Algol occur at 10h. 32m. P.M. on the 7th; at 7h. 21m. P.M. on the 10th; at 0h. 14m. A.M. on the 27th, and at 9h. 3m. P.M. on the 30th.

Mercury is too near the Sun to be visible in September.

Venus is too near the Sun to be observed during the greater part of the month; afterwards she becomes a morning star. On the 24th she rises at 5h. 30m. A.M., with a southern declination of 4° 26′, and an apparent diameter of $58\frac{1}{4}''$, $\frac{8}{100}$ths of the disc being illuminated. On the 30th she rises at 4h. 49m. A.M., or 1h. 49m. before the Sun, with a southern declination of 2° 28′, and an apparent diameter of $54\frac{1}{4}''$, $\frac{5}{100}$ths of the disc being illuminated. While visible she describes a short retrograde path in the extreme south of Leo.

Mars is invisible, and Saturn and Uranus have left us for the season.

Vesta is an evening star, and but for her great southern declination would be well situated for observation. On the 1st she souths at 11h. 45m. P.M., with a southern declination of 20° 23′. On the 15th she souths at 10h. 35m. P.M., with a southern declination of 21° 31′. On the 30th she souths at 9h. 29m. P.M., with a southern declination of 21° 53′. During September she appears as a $6\frac{3}{4}$ magnitude star. A map of the small stars near her path will be found in the *English Mechanic* for August 2nd.

Jupiter is a morning star, rising on the 1st at 1h. 28m. P.M., with a northern declination of 20° 33′, and an apparent equatorial diameter of $33\frac{1}{2}''$. On the 8th he rises at 1h. 8m. A.M., with a northern declination of 20° 17′, and an apparent equatorial diameter of 34″. On the 18th he rises at 0h. 39m. A.M., with a northern declination of 19° 54′, and an apparent equatorial diameter of $33\frac{3}{4}''$. On the 30th he rises at midnight, with a northern declination of 19° 28′, and an apparent equatorial diameter of $35\frac{1}{4}''$. He describes a direct path during September in Cancer, being a little to the S.W. of Præsepe at the end of the month. The following phenomena of the satellites occur while the planet is more than 8° above and the Sun 8° below the horizon. On the 5th a transit ingress of the shadow of the second satellite at 2h. 40m. A.M., and of the satellite itself at 4h. 27m. A.M. On the 6th a transit ingress of the shadow of the first satellite at 3h. 39m. A.M., and a transit ingress of the satellite itself at 4h. 32m. A.M. On the 7th an occultation reappearance of the first satellite at 4h. 10m. A.M. On the 12th a transit egress of the shadow of the third satellite at 2h. 18m. A.M., and at 2h. 43m. A.M. a transit ingress of the satellite itself. On the 14th an eclipse disappearance of the first satellite at 2h. 51m. 56s. A.M., and an occultation reappearance of the second satellite at 4h. 32m. A.M. On the 15th a transit egress of the shadow of the first satellite at 2h. 20m. A.M., and of the satellite itself at 3h. 20m. A.M. On the 19th a transit ingress of the shadow of the third satellite at 2h. 49m. A.M. On the 21st an eclipse disappearance of the second satellite at 2h. 17m. 7s. A.M., and an eclipse disappearance of the first satellite at 4h. 45m. 13s. A.M. On the 21st a transit ingress of the shadow of the first satellite at 1h. 53m. A.M., of the satellite itself at 2h. 49m. A.M., and a transit egress of its shadow at 4h. 14m. A.M. On the 23rd a transit egress of the second satellite at 2h. 8m. A.M., and an occultation reappearance of the first satellite at 2h. 35m. A.M. On the 28th an eclipse disappearance of the second satellite at 4h. 53m. 26s. A.M. On the 29th a transit ingress of the shadow of the first satellite at 3h. 49m. A.M., and of the satellite itself at 4h. 57m. A.M. On the 30th an eclipse disappearance of the first satellite at 1h. 6m. 43s. A.M., an occultation disappearance of the third satellite at 1h. 18m. A.M., a transit ingress of the second satellite at 1h. 57m. A.M., and a transit egress of its shadow at 2h. 28m. A.M.; an occultation reappearance of the first satellite at 4h. 33m. A.M., a transit egress of the second satellite at 4h. 50m. A.M., an occultation reappearance of the third satellite at 4h. 52m. A.M.

Neptune is an evening star, and is becoming well situated for observation. He rises on the 1st at 10h. 24m. P.M., with a northern declination of 21° 28′, and an apparent diameter of 2·6″. On the 30th he rises at 8h. 26m. P.M., with a northern declination of 21° 28′. During September he is almost stationary at about $\frac{3}{4}$° S.S.W. of the $6\frac{1}{3}$ magnitude star 108 Tauri. A map of the small stars near his path is given in the *English Mechanic* for August 16th.

There are no very well marked showers of shooting stars in September.

The Moon is full at 5h. 55m. A.M. on the 4th; enters her last quarter at 4h. 51m. A.M. on the 12th; is new at 8h. 55m. P.M. on the 18th; and enters her first quarter at 6h. 23m. P.M. on the 25th. She is in apogee at 10h. P.M. on the 3rd (distance from the earth 252,430 miles), and in perigee at 7h. A.M. on the 18th (distance from the earth 222,300 miles). There will be a total eclipse of the Moon on the morning of the 4th. First contact with penumbra at 2h. 49·7m. A.M.; first contact with shadow at 4h. 0·3m. A.M. at 54° from the northernmost point of the Moon's limb towards the east (reckoned for direct images); beginning of total phases 5h. 6·9m. A.M. (the Moon sets at Greenwich at 5h. 18m.); middle of the eclipse 5h. 57m. A.M.; end of total phases 6h. 47·1m. A.M.; last contact with shadow at 7h. 53·7m. A.M., at 110° from the northernmost portion of the limb towards the west; last contact with penumbra 9h. 4·3m. A.M. (magnitude of eclipse (Moon's diameter = 1) 1·55). At 1h. 54m. A.M. on the 3rd the 4th magnitude star ι Aquarii will disappear at an angle of 87°, and reappear at 2h. 53m. A.M. at an angle of 205°. At 6h. 12m. P.M. on the 3rd the 6½ magnitude star 64 Aquarii will disappear in sunlight at an angle of 41°, the star being below the horizon of Greenwich at the time, and reappear at 7h. 10m. P.M. at an angle of 269°. At 5h. 58m. P.M. on the 4th the 6½ magnitude star B.A.C. 8134 will disappear at an angle of 74°, the star being below the horizon at the time, and reappear at 6h. 57m. P.M. at an angle of 233°. At 7h. 7m. P.M. on the 6th the 6th magnitude star 60 Piscium will disappear at an angle of 108°, the star rising at the time, and reappear at 7h. 46m. P.M. at an angle of 194°; and the 6th magnitude star 62 Piscium will disappear at 8h. 4m. P.M., at an angle of 8°, and reappear at 8h. 40m. P.M. at an angle of 292°. At 2h. 41m. A.M. on the 16th the 6th magnitude star 83 Cancri will disappear at an angle of 111°, and reappear at 3h. 35m. A.M. at an angle of 282°. At 8h. 48m. P.M. on the 29th the 3rd magnitude star δ Capricorni will disappear at an angle of 50°, and reappear at 10h. 8m. P.M. at an angle of 241°. At 9h. 9m. P.M. on the 30th the 6th magnitude star 58 Aquarii will disappear at an angle of 56°, and reappear at 10h. 30m. P.M. at an angle of 230°; another 4½ magnitude star σ Aquarii will make a near approach to the lower limb at 9h. 29m. P.M., at an angle of 324°.

Chess Column.

By C. D. Locock, B.A.Oxon.

Communications for this column should be addressed to C. D. Locock, Burwash, Sussex, and posted on or before the 12th of each month.

Solutions of August Problems.

(A. G. Fellows.)

No. 1.

1. Q to Bsq, and mates next move.

No. 2.

2. Kt to B3, and mates next move.

CORRECT SOLUTIONS of both problems received from A. Louis, E. W. Brook, J. T. Blakemore, W. Willby, J. M'Robert, Alpha, H. S. Brandreth.

Of No. 1 only, from G. G. Beazley and Dr. Hardwick.

No. 2 has proved to be unusually difficult for a two-mover.

A. C. Challenger.—Many thanks. Your contributions are always acceptable.

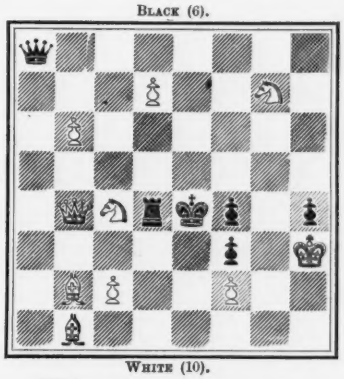
J. T. Blakemore.—Have answered by post.

PROBLEMS.

By A. C. CHALLENGER.

No. 1.

BLACK (6).

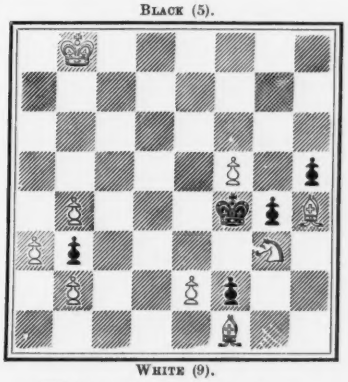


WHITE (10).

White mates in two moves.

No. 2.

BLACK (5).



WHITE (9).

White mates in four moves.

The following game was played in the eighth round of the Hastings Tournament. Mr. Lasker was again the first to finish his game.

"Ruy Lopez."

WHITE. E. Lasker.	BLACK. A. Walbrodt.
1. P to K4	1. P to K4
2. Kt to KB3	2. Kt to QB3
3. B to Kt5	3. Kt to B3
4. Castles	4. B to K2 (*a*)
5. Kt to B3 !	5. P to Q3 (*b*)
6. P to Q4	6. P × P (*c*)
7. Kt × P	7. B to Q2
8. KKt to K2 (*d*)	8. Castles (*e*)
9. Kt to Kt3	9. Kt to K4 (*f*)
10. B × B	10. Q × B
11. P to Kt3 (*g*)	11. QR to Qsq
12. B to Kt2	12. Kt to B3 (*h*)
13. Kt to B5	13. Q to K3 (*i*)
14. R to Ksq	14. Kt to K4
15. P to B4	15. Kt to Kt3
16. Kt to Q5 ! (*j*)	16. P to B3
17. Kt(B5) × Bch	17. Kt × Kt
18. P to B5	18. Kt × P(*k*)
19. Kt × Ktch	19. P × Kt

XUM

20. P × Kt	20. Q × BP
21. R to KBsq	21. Q to K5
22. B × P	22. QR to Ksq
23. R to B3	23. P to KR4
24. R to Kt3ch	24. Resigns.

NOTES.

(*a*) It is not generally known that B to K2 is inferior at this stage, though German analysts have demonstrated the fact.

(*b*) The alternative 5. . . . Kt to Q5 is very risky. Zukertort continued with 6. Kt × Kt, P × Kt; 7. P to K5, P × Kt; 8. P × Kt, with a winning game.

(*c*) If 6. . . . B to Q2, 7. P to Q5, Kt to QKtsq; 8. B to Q3, with the advantage according to Von Bardeleben. We should prefer, however, 7. R to Ksq, in reply to which Black cannot castle, on account of the well-known variation 7. . . . castles; 8. B × Kt, B × B; 9. P × P, P × P; 10. Q × Q, QR × Q; 11. Kt × P, B × P; 12. Kt × B, Kt × Kt; 13. Kt to Q3!, P to KB4; 14. P to KB3, B to B4ch; 15. Kt × B, Kt × Kt; 16. B to Kt5, winning the exchange.

(*d*) A new and excellent move. Bardeleben gives instead 8. Kt × Kt, P × Kt; 9. B to Q3, castles; 10. P to KR3, with a good game.

(*e*) Castling seems premature in so cramped a position. We would suggest 8. . . . Kt to K4 at once; if then 9. B × Bch, Q × B, reserving the option of castling on either wing.

(*f*) Very dangerous now, as it allows the entrance of the White Knight at KB5. The *Standard* suggests 9. . . . R to Ksq.

(*g*) This development of the QB in the Ruy Lopez is now fashionable. It was introduced by Showalter and Tarrasch.

(*h*) As pointed out by the *Standard* he cannot play 12. . . . P to Q4, on account of 13. P × P, Kt × P; 14. Kt × Kt, Q × Kt; 15. Q × Q, R × Q; 16. P to QB4, winning a piece. For this reason he moves the Knight, but to the wrong square. By playing it to Kt3 at once he would save two moves.

(*i*) 13. . . . Kt × P would be very dangerous on account of the reply 14. Q to Kt4, with a winning game.

(*j*) Very prettily played. If Black reply 16. . . . Kt × Kt, 17. Kt × KtP, wins.

(*k*) Clearly forced; if 18. . . . Q to Q2, 19. Kt × Ktch, P × Kt; 20. Q to Kt4ch, Kt to Kt3; 21. Q to Kt3, etc.

RECEIVED FOR REVIEW.—*The Chess Openings.* By I. Gunsberg. (George Bell & Sons.) Our notice of this book is unavoidably held over till next month.

CHESS INTELLIGENCE.

The whole attention of the chess world is now concentrated on Hastings, where the International Tournament began on August 5th. None of the selected twenty-two failed to keep their engagements, so that the reserve (Herr Van Lennep) was not called upon. So much space has been given to the tournament in the leading daily papers, that a detailed report at this stage is unnecessary. A few leading incidents of the first portion of the tourney may, however, be mentioned. Undoubtedly the most remarkable feature of the first week was the unfortunate start made by Dr. Tarrasch, the winner of the last three international tournaments. At the end of the sixth round his score was actually only 2. After ten rounds his score was 5, and he will no doubt obtain a prize, though probably not one of the highest. In opposition to this may be placed the splendid performance of Tchigorin, who won eight out of his first nine games, and the almost equal success of the young American, H. N. Pillsbury, who scored $8\frac{1}{2}$ out of 10. Bardeleben held the unbeaten record longer than any other player, finally succumbing to Steinitz in the tenth round. The latter player was leading at the end of the fifth round, but then four consecutive losses rendered his case almost hopeless as far as the first prize is concerned. Of the three principal favourites, Lasker alone showed anything like his true form in the opening stages. He scored $7\frac{1}{2}$ out of 10, one point behind Pillsbury and Tchigorin, and equal with Bardeleben. It would seem that the first prize is destined to go to one of these four. Of the other players Bird has done well, and Blackburne very badly; Gunsberg and Mason have performed moderately, as also Marco and Janowski. Mieses started well, but subsequently fell off; Burn, on the contrary, has improved on a very bad start. Teichmann, who recently lost a hard-fought match with Bardeleben in London, has done fairly well, and Pollock has justified his selection by beating Steinitz. Walbrodt and Schiffers have been difficult to beat; Janowski has more than once beaten himself. Schlechter's score is a curiosity—no wins, one loss, and nine draws. This has not an enterprising sound, and yet his drawn game with Bardeleben was perhaps the most daring in the tourney.

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TWO PLATES.—1, The Pitcher-Plant; 2, Photograph of the Cluster Messier 46, and the Nebula Herschel IV. 39 Argûs.

NOTICES.

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